

2.5 COST AND MANAGEMENT ACCOUNTING

2.5.1 Marginal Costing and Break Even Analysis

Marginal Costing is a decision making technique whereas above mentioned methods are useful for cost ascertainment of some activity or job. The term Marginal Costing is widely used in economics. In Cost Accounting Marginal Costing means aggregate amount of variable costs.

According to the Institute of Cost and Management Accountants, London, "Marginal Costing is the ascertainment, by differentiating between fixed costs and variable costs, of marginal cost and of the effect of profit of changes in the volume or type of output."

In this technique of costing only variable costs are charged to operations, processes or products, leaving all indirect costs to be written off against profits in the period in which they arise.

Thus, in this context, marginal costing is not a system of costing such as process costing, job costing, operating costing, etc. but a technique which is concerned with the changes in costs and profits resulting from changes in the volume of output. Marginal costing is also known as '**Variable Costing**'.

Features of Marginal Costing

The main features of marginal costing are as follows :

- (1) **Cost Classification** : The marginal costing technique makes a sharp distinction between variable costs and fixed costs. It is the variable cost on the basis of which production and sales policies are designed by a firm following the marginal costing technique.
- (2) **Stock/Inventory Valuation** : Under the marginal costing, inventory/stock for profit measurement is valued at the marginal cost. It is in sharp contrast to the total unit cost in costing method.
- (3) **Marginal Contribution** : Marginal costing technique makes use of marginal contribution for making various decisions. Marginal contribution is the difference between sales and marginal cost. It forms the basis for judging the profitability of different products or departments.
- (4) **Selling Price Determination** : Selling price of the product in the marginal costing method is determined based on the cost plus the contribution always. Here, the contribution, of course, means the difference between the sales and the variable cost.
- (5) **Profitability** : The profitability of the product/department is based on the contribution made available by each product/department.
- (6) **Fixed Costs vs. Period Costs** : Fixed costs are treated as period costs and are charged to the costing Profit and Loss Account of the period in which they are incurred.

Absorption Costing

Absorption Costing technique is also termed as Traditional or Full Cost Method. According to this method, the cost of a product is determined after considering both Fixed and Variable Costs. The Variable Costs, such as those of direct materials, direct labour, etc., are directly charged to the products while the fixed costs are apportioned on a suitable basis over different products manufactured during a period. Thus, in case of Absorption Costing all costs are identified with the manufactured products.

Marginal Costing

Marginal costing is a technique where only the variable costs are considered while computing the cost of a product. The fixed costs are met against the total fund arising out of the excess of selling price over total variable cost. This fund is known as 'contribution' in marginal costing. According to the Chartered Institute of Management Accountants, London, marginal costing is a technique where 'only the variable costs are charged to cost units, the fixed costs attributable being written off in full against the contribution for that period'.

Difference Between Absorption and Marginal Costing

Absorption Costing both fixed and variable overheads are charged to production. On the other hand, in Marginal Costing, only variable overheads are charged to production while fixed overheads are transferred in full to the costing and profit and loss account.

Absorption Costing stocks of work-in-progress and finished goods are valued at works cost and total cost of production, respectively. The works cost or cost of production so used includes the amount of fixed overheads also. In case of Marginal Costing, only variable costs are considered while computing the value of work-in progress or finished goods.

ABSORPTION COSTING		MARGINAL COSTING	
Net turnover		Net turnover	
Less:		Less:	
Direct Materials		Direct Materials	} Variable Cost of Sales
Direct Labour		Direct Labour	
Total Production Overhead	Production Cost of Sales	Variable Production Overhead	
	Gross (or Factory) Profit	Variable Selling and Distribution Overhead	
Less:			Contribution
Selling Overhead		Less fixed costs:	
Distribution Overhead		Production Overhead	
Administrative Expenses		Selling Overhead	
R&D Cost	Non-production Overhead	Distribution Overhead	
	Net Profit before Tax	Administrative Expenses	
		R&D Cost	Total Fixed Cost
			Net Profit before Tax

Fig. : (Budgeted Trading and Profit and Loss Accounts, Absorption Costing and Marginal Costing)

Note : In an 'actual' absorption costing-based Trading and Profit and Loss Account, production overhead would normally be over-or under-absorbed, due to both cost and activity levels differing from those upon which the budget was based.

An over-absorption occurs when overhead costs absorbed by output exceed the actual costs incurred.

An under-absorption occurs when the actual costs incurred exceed the overhead costs absorbed by output.

Marginal Cost

The technique of Marginal Costing is concerned with 'Marginal Cost'. It is, therefore, very necessary that the term 'Marginal Cost' is correctly understood. According to the Chartered Institute of Management Accountants, London, the term 'Marginal Cost' means 'the amount at any given volume of output by which aggregate costs are changed if the volume of output is increased or decreased by one unit'. On analyzing this definition we can conclude that the term 'Marginal Cost' refers to increase or decrease in the amount of cost on account of increase or decrease of production by a single unit.

$$\text{Marginal Cost} = \text{Total Variable Cost}$$

Contribution

Revenue and total variable costs are the two things that change as a business's sales/production volume changes. The difference between a business's revenues and total variable costs is referred to as its "contribution margin." That is :

Contribution margin = Sales – Variable costs

Or

Contribution = Fixed Cost + Profit (C = F + P)

Contribution Margin Ratio = $\frac{\text{Contribution Margin Per Unit}}{\text{Sales Price Per Unit}}$

Example : A company manufactures a single product having a marginal cost of Re. 0.75 per unit. Fixed costs are Rs. 12,000. The market is such that up to 40,000 units can be sold at Rs. 1.50 per unit, but any additional sales must be made at Re. 1.00 per unit. There is a planned profit of Rs. 20,000.

How many units must be made and sold ?

Solution :

Contribution desired = Fixed Cost + Desired Profit
 = Rs. 12,000 + Rs. 20,000
 = Rs. 32,000
 Contribution from 40,000 units
 = 40,000 x Rs. (1.50 - 0.75)
 = Rs. 30,000

Additional units to be produced and sold at Re. 1.00 per unit after 40,000 units:

Contribution to be earned after 40,000 units

= Rs. (32,000 – 30,000)
 = Rs. 2,000

New contribution per unit

= Rs. (1.00 – 0.75)
 = Rs. 0.25

Additional units to be produced for contribution of Rs. 2,000

= Rs. 2,000 x 100/25
 = 8,000 units.

Total units to be produced to earn planned profit of Rs. 20,000

= 40,000 units + 8,000 units
 = 48,000 units.

Profit Volume Ratio

Profit Volume Ratio means the ratio of profit (in term of contribution) and Volume in terms of sales for this purpose. In simple language sales activity means volume, contribution and volume for this purpose means amount of sales.

$$P/V \text{ Ratio} = \frac{\text{Contribution}}{\text{Sales}} = \frac{\text{Change in Contribution}}{\text{Change in sales}} = \frac{\text{Change of Profit}}{\text{Change in Sales}}$$

A high P/V ratio indicates high profitability so that a slight increase in volume, without increase in fixed cost, would result in high profits. A low P/V ratio, on the other hand, is a sign of low profitability so that efforts should be made to improve P/V ratio.

Uses of P/V Ratio:

- (i) It helps in the determination of Break-even-point [BEP = Fixed cost ÷ P/V ratio]
- (ii) It helps in the determination of profit at any volume of sales
 [Sales x P/V ratio = Contribution, Profit = Contribution – Fixed Cost]
- (iii) It helps in determining margin of safety [Margin of safety = Profit ÷ P/V ratio]

Margin of Safety

The margin of safety is the amount of sales over a company's break-even point. In other words, the margin of safety is the amount of sales a company can lose before it actually starts to lose money or stops making a profit.

Margin of safety = Actual or budgeted sales – Sales required to break-even

Margin of safety is also expressed in the form of ratio or percentage that is calculated by using the following formulas:

MOS ratio = MOS/Actual or budgeted sales

MOS percentage = (MOS/Actual or budgeted sales) × 100

Example : The following data relates to Noor enterprises for the Month of June 2015.

- Sales (3,500 units @ Rs. 20/unit): Rs. 70,000
- Contribution margin per unit: Rs. 12
- Total fixed expenses for the month: Rs. 15,000

There was no opening and closing finished goods inventory in stock.

Required : Calculate margin of safety for the Noor enterprises using above data.

Margin of safety = Actual sales - Break-even sales

= Rs. 70,000 - Rs. 25,000*

= Rs. 45,000

Or

= 45,000/70,000

= 0.6429

Or

= 64.29%

Break Even Point (BEP)

The Break- even Point is the sales volume at which there is neither Profit nor loss, cost being equal to sales revenue. If contribution (C) obtained from the sales of goods and service is exactly equal to the fixed costs (F) only and profit earned (P) is Zero then such level of sales is known as Break even sales. Or Point.

Break Even Point can be computed either in terms of value or in terms of quantity in units. Such as

(a) BEP in Value

$$\frac{\text{Monthly Sales} - \text{Variable Expenses}}{\text{Monthly Sales}} = \text{Contribution Margin}$$

$$\text{Break-even Sales} = \frac{\text{Fixed Expenses}}{\text{Contribution Margin}}$$

(b) BEP in Units

Break-even sales (units) = Fixed costs / Contribution margin per unit

Break-even sales (volume) = Fixed costs / C/S ratio (also known as P/V ratio) or

Break-even sales volume = Total fixed expenses/1 – (Total variable expenses/Total sale volume)

BEP Chart

Under this type of BEC, the total variable costs, i.e. direct materials, direct labour, variable overhead are represented in this graph together with the appropriation items, like dividend on equity shares, dividend on preference shares, income-tax and retentions are plotted. In this respect it may be

mentioned that if this chart contains only the details of appropriation of profit it may be called profit-appropriations Break Even Cost.

For example, the gap between price and unit variable cost (often called marginal cost) is the contribution margin, That is, the amount contributed toward Fixed costs and profits. In the very short run, it may be attractive to cut prices below the normal level which would recover all the Fixed costs and deliver some profits to a level that would at least make possible some recovery of Fixed costs. This may be attractive because otherwise these sales might not take place at all (a typical recession scenario).



Fig. : Break-Even Chart

Initial change	Which curve is affected	What happens to QBE
Increase in output price	TR curve, counterclockwise	Decrease
Increase in the price of a variable input	TVC and TC curves, both counter clockwise	Increase
Higher TFC	TFC curve, parallel-shift up	Increase

CVP (Cost Volume Profit)

Cost-volume-profit (CVP) analysis is a technique that examines changes in profits in response to changes in sales volumes, costs and prices. Accountants often perform CVP analysis to plan future levels of operating activity and provide information about :

- Which products or services to emphasize
- The volume of sales needed to achieve a targeted level of profit
- The amount of revenue required to avoid losses
- Whether to increase fixed costs
- How much to budget for discretionary expenditures
- Whether fixed costs expose the organization to an unacceptable level of risk

Profit Equation and Contribution Margin

CVP analysis begins with the basic profit equation.

$$\text{Profit} = \text{Total revenue} - \text{Total costs}$$

Separating costs into variable and fixed categories, we express profit as :

$$\text{Profit} = \text{Total revenue} - \text{Total variable costs} - \text{Total fixed costs}$$

The contribution margin is total revenue minus total variable costs. Similarly, the contribution margin per unit is the selling price per unit minus the variable cost per unit. Both contribution margin and contribution margin per unit are valuable tools when considering the effects of volume on profit. Contribution margin per unit tells us how much revenue from each unit sold can be applied toward fixed costs. Once

enough units have been sold to cover all fixed costs, then the contribution margin per unit from all remaining sales becomes profit.

2.5.2 Standard Costing

Standard costing are pre-determined estimates of cost of a single unit or a number of units of a product or service. Standard costing is the establishment of cost standards for activities and their periodic analysis to determine the reasons for any variances. Standard costing is a tool that helps management account in controlling costs.

According to CIMA London "The preparation and use of standard costs their comparison with actual costs and the analysis of variances of their causes and point of incidence"

Standard costing is a method of ascertaining costs whereby statistics are prepared to show :

- (a) The Standard Cost
- (b) The Actual Cost
- (c) The difference between these costs which is termed as variance.

Standard Costing are used in all type of industries but it is proved to be more effective in the industries. Standard cost accounting is an instrument or a technique the scope of which beings with the constituents of costs related with various elements of costs viz. Material, Labour and Overhead and analysis of variance.

Objective of Standard Costing

- To establish Control
- To set Standards for various Elements of Cost
- To Fix Responsibility
- To Make Budgetary Control More Effective

Advantages of Standard Costing

- (i) Standard Costing serves as a guide to the management in several management functions while formulating prices and production policies etc.
- (ii) More effective cost control is possible under standard costing if the same is reviewed and analyzed at regular intervals for improvements and immediate action can be taken if deviations from standards are found out which, ultimately, leads to cost reduction.
- (iii) Analysis of variance and its measurement helps to detect inefficiencies and mistakes which enable the management to investigate the reasons.
- (iv) Since standard costs are predetermined costs they are very useful for planning and budgeting. It also helps to estimate the effect of changes in Cost-Price-Volume relationship which also helps the management for decision-making in future.
- (v) As standard is fixed for each product, its components, materials, process operation etc. It improves the overall production efficiency which also ultimately reduces cost and thereby increases profit.
- (vi) Once the Standard Costing System is implemented it will lead to saving cost since most of the costing work can be eliminated.
- (vii) Delegation of authority and responsibility becomes effective by setting up standards for each cost center as the supervisors or executives of each cost center will know the standard which they have to maintain.
- (viii) This system also helps to prepare Profit and Loss Account promptly for short period to know the trend of the business which helps the management to take decisions promptly.
- (ix) Standard costing also is used for inventory valuation purposes. Stock can be valued at standard cost which can reduce the fluctuation of profit for different methods of valuation for the same.

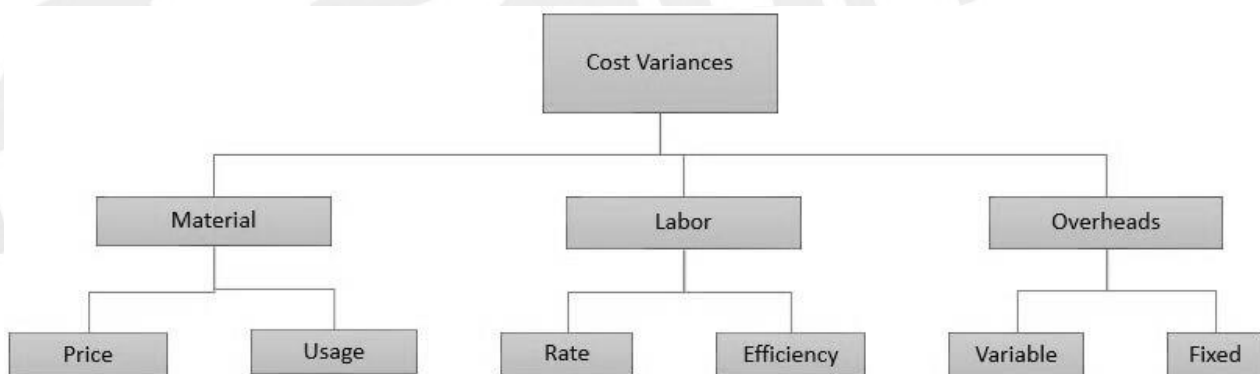
- (x) Efficiency of labour is promoted.
- (xi) This system creates cost-consciousness among all employees, executives and top management which increase efficiency and productivity as well.

Disadvantages of Standard Costing

- (i) Since Standard Costing involves high degree of technical skill, it is, therefore, costly. As such, small organizations cannot, introduce the system due to their limited financial resources. But, once introduced, the benefits achieved will be far in excess to its initial high costs.
- (ii) The executives are liable for those variances that are found from actions which are actually controllable by them. Thus, in order to fix up the responsibilities, it becomes necessary to segregate variances into non-controllable and controllable portions although that is not an easy task.
- (iii) Standards are always changing since conditions of the business are equally changing. So, standards are to be revised in order to make them comparable with actual results. But revision of standards creates many problems, particularly in inventory adjustment.
- (iv) Standards are either too liberal or rigid since the same are based on average past results, attainable good performance or theoretical maximum efficiency. So, if the standards are very high, it will adversely affect the morale and motivation of the employees.

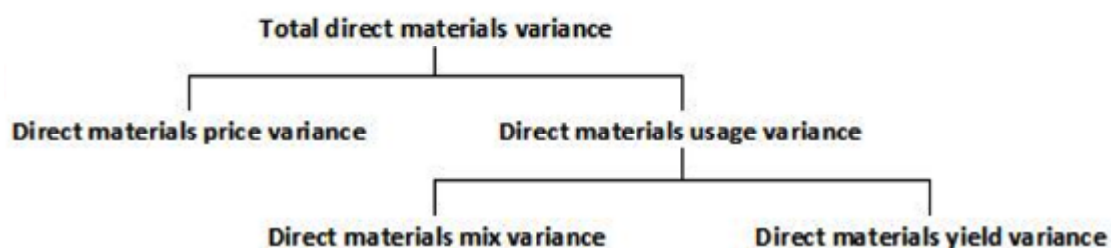
Classification of Variance

When Standard Cost is compared with the actual cost generally a difference is found between the two. This difference is known as Variance. Together, variances can help to reconcile the total cost difference by comparing actual and standard cost. The main purpose of variances is to provide reasons for off-standard performance. In this way, management can improve operations, correct errors and deploy resources more effectively to reduce costs.



Material Variance

Material Variance is the difference between the standard cost of direct material specified for the output achieved and the actual cost of direct material used. Thus the amount obtained on subtracting the actual cost of the material from its standard cost is known as material cost variance.



Direct Material Variance (MCV)

Material Cost Variance is the difference between the standard cost of direct materials specified for the output achieved and the actual cost of direct material used. Thus the amount obtained on subtracting the actual cost of the material from its standard cost is known as material cost variance.

$$\text{MCV} = (\text{SP} \times \text{SQ}) - (\text{AP} \times \text{AQ}) \quad \text{or} \quad (\text{SQ} \times \text{SP}) - (\text{AQ} \times \text{AP})$$

SP = Stands for Standard Price per Unit of Material

SQ = Stands for Standard Quantity of Material to use for actual output.

AP = stands for Actual Price per Unit of Material

AQ = Stands for Actual Quantity of Material Used.

Material Price Variance (MPV)

Material Price Variance is that portion of the material cost variance which is due to the difference between the standard price specified and actual price paid.

$$\text{MPV} = (\text{SP} - \text{AP}) \times \text{AQ}$$

SP = Stands for Standard Price per Unit of Material

AP = stands for Actual Price per Unit of Material

AQ = Stands for Actual Quantity of Material Used.

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Material Usage Variance (MUV)

Material Usage Variance is that portion of the material Cost Variance which is due to the difference between the standard quantity specified and actual quantity used.

$$\text{MUV} = (\text{SQ} - \text{AQ}) \times \text{SP}$$

Check

$$\text{MCV} = \text{MPV} + \text{MUV}$$

Material Mix Variance (MMV)

The materials mix variance arises when the mix of materials used differs from the predetermined mix included in the calculation of the standard cost of an operation. If the mixture is varied so that a larger than standard proportion of more expensive materials is used, there will be an unfavorable variance. When a larger proportion of cheaper materials are included in the mixture, there will be a favorable variance.

$$\text{Materials mix variance} = (\text{actual quantity in standard mix proportions} \\ - \text{actual quantity used}) \times \text{standard price}$$

OR

$$\text{MMV} = (\text{AQM} - \text{SQM}) \text{SP}$$

Material Yield Variance (MYV)

The materials yield variance arises because there is a difference between the standard output for a given level of inputs and the actual output attained.

$$\text{Materials yield variance} = (\text{actual yield} - \text{standard yield from actual input of material}) \\ \times \text{standard cost per unit of output}$$

OR

$$\text{MYV} = (\text{AY} - \text{SY})\text{SR}$$

AY = Actual Yield

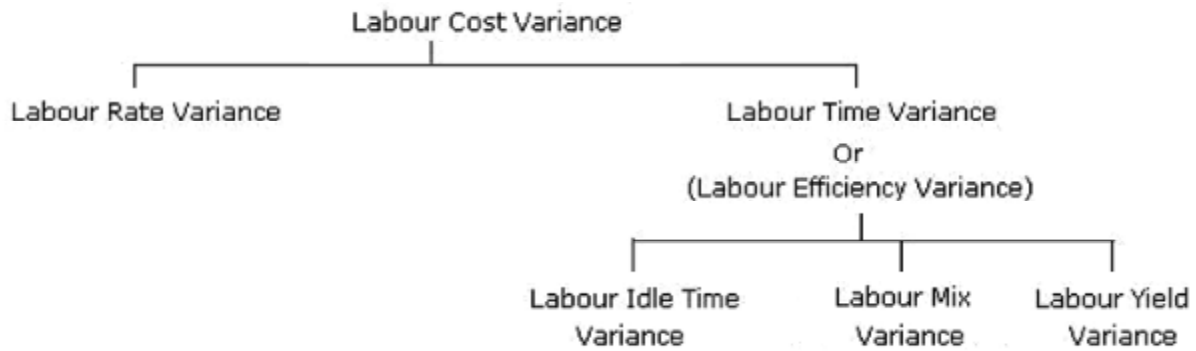
SY = Standard Yield

SR = Standard Rate per Unit

SR is calculated

Total cost of Standard Mix/Net Standard Output

Direct Labour Variance



Labour Cost Variance

Labour Cost Variance is the difference between standard cost of labour specified and actual cost of labour employed.

$$\text{Labour Cost Variance} = \text{Total Standard Labour Cost} - \text{Total Actual Labour Cost}$$

Labour Rate Variance : Labour Rate Variance is that portion of labour cost variance which is due to the difference between standard rate specified and actual rate paid.

$$\text{Labour Rate Variance} = (\text{Standard rate per hour} - \text{Actual Rate per Hour}) \times \text{Actual Hour}$$

Labour Efficiency Variance : The labor efficiency variance measures the ability to utilize labor in accordance with expectations. The variance is useful for spotlighting those areas in the production process that are using more labor hours than anticipated.

$$(\text{Standard Time} - \text{Actual Time}) \times \text{Standard Rate per hour}$$

Labour Ideal Time Variance : Idle time variance is the part of labor variance which happens due to abnormal idle time. We can calculate idle time variance by multiplying standard wage rate with abnormal idle time.

$$\text{Labour Idle Time Variance} = \text{Abnormal Idle Time} \times \text{Standard Rate Per Hour}$$

Labour Mix Variance : Different Type of workers are generally required in a production e.g. Skilled and unskilled. Keeping in view the production efficiency of the factory and control the labour cost a standard mix ratio is specified for various type of worker.

In each two situation mentioned above labour mix variance will be calculated as follows:

When the total of standard labour mix and actual labour mix are same but the two mix ratios are different:

$$\text{Labour Mix Variance} = (\text{Standard time mix} - \text{Actual Time Mix}) \times \text{Standard rate per hour}$$

When the totals of standard labour mix and actual labour mix are different and the two mix ratio are also different :

$$\text{Labour Mix Variance} = (\text{Revised Standard Time} - \text{Actual Time}) \times \text{Standard rate per hour}$$

Revised Efficiency Variance : The residue of efficiency variance which is left after the labour mix variance has been segregated there from represents revised efficiency variance. Due to actual hours being more or less the number of hours according to the standard which has been specified for actual output, the variation in labour cost is highlighted by revised efficiency variance. The calculation is made in the same manner in which the calculation of revised usage variance of material is done.

The formula is :

$$\text{Standard rate} \times (\text{Standard hours} - \text{Revised standard hours})$$

Relationship between the variances :

$$\text{Total Labour cost variance} = \text{Rate variance} + \text{Efficiency variance} + \text{Idle time variance}$$

$$\text{Efficiency variance} = \text{Mix variance} + \text{Revised efficiency variance}$$

Analysis Overhead Variance : The analysis of the material, labour and variable overhead variances is easy as these are direct costs and these variances vary with the production, whereas analysis of the fixed overhead variances is somewhat difficult as not only there is a relation between fixed cost and time but also with capacity and fixed costs do not vary with production.

Fixed Overhead Cost Variance : The difference between the standard fixed overhead for actual output (i.e., fixed overhead that has been recovered) and the actual fixed overhead which has been incurred, is known as fixed overhead cost variance.

$$\text{Fixed overhead recovered} - \text{Actual fixed overhead}$$

The division of fixed overhead cost variance can be made into fixed overhead expenditure variance and fixed overhead volume variance.

Fixed Overhead Expenditure Variance : The distinction between the fixed overhead which has been actually incurred and the fixed overhead which has been originally budgeted is known as fixed overhead expenditure variance.

The formula is :

$$\text{Actual fixed overhead} - \text{Budgeted fixed overhead}$$

Whereas,

$$\text{Budgeted overhead} = \text{Budgeted hours} \times \text{Standard rate per hour}$$

$$\text{Or, Budgeted output} \times \text{Standard rate per unit}$$

Note : The terms 'budgeted overhead' and 'standard overhead' cannot be used in the same sense. For budgeted time or output, the budgeted overhead is used and for actual time or for standard output of actual time, standard output is used.

Fixed Overhead Volume Variance : The amount of any under- or over-recovery of overheads which arises because of difference between the actual output and the budgeted is measured by the fixed overhead volume variance.

The formula is :

$$(\text{Budgeted hours} - \text{Standard hours of actual output}) \times \text{Standard fixed overhead rate per hour}$$

$$\text{Or, } (\text{Budgeted output} - \text{Actual output}) \times \text{Standard fixed overhead rate per unit}$$

$$\text{Or, Budgeted fixed overhead} - \text{Fixed overhead recovered}$$

Reasons of occurrence of Volume Variance are :

- There is a decrease in the consumer demand.
- Plant capacity is in excess.
- Due to poor scheduling or input bottlenecks, there is a stoppage of plant.
- Allowances have not been made as a result of fluctuations of calendar.

Analysis of fixed overhead volume variance can be done into fixed overhead capacity variance and fixed overhead efficiency variance. Due to the following two factors, the difference between the actual production and the expected production (the volume) arises :

- a change in the time worked (capacity) and a change in the efficiency with which the use of time is done.

Fixed Overhead Capacity Variance

Under- or over-recovery of overhead arises as a result of a change in capacity, other things being equal; because, an equivalent overhead recovery or non-recovery will be there for every hour difference. Therefore, the difference between the budgeted and actual hour which is multiplied by overhead rate per hour is known as the fixed overhead capacity variance.

The formula is :

$$\text{Standard fixed overhead rate per hour} \times (\text{Budgeted hours} - \text{Actual hours})$$

$$\text{Or, } \text{Standard fixed overhead rate per hour} \times (\text{Budgeted output} - \text{Standard output in actual hours})$$

$$\text{Or, } \text{Budgeted fixed overhead} - \text{Standard fixed overhead}$$

Reasons of occurrence of Fixed Overhead Capacity Variance is

(i.e. the reasons why actual activity and normal activity are not equal):

- There are bottlenecks and low output which arises as a result of poor production scheduling.
- There are machine breakdowns which are not expected.
- There is a shortage of skilled operatives or materials.
- Strikes
- Natural calamities such as flood etc.

If any idle time is included in the changed capacity, then extraction and analysis of the same has to be made separately as is done for fixed overhead idle time variance.

The formula is :

$$\text{Idle hours} \times \text{Standard fixed overhead rate per hour}$$

$$\text{Or, } \text{Production lost in idle hours} \times \text{Standard fixed overhead rate per unit.}$$

Fixed Overhead Efficiency Variance

With labour efficiency variance, this variance is closely related to. Under- or over- recovery of fixed overhead arises as a result of a change in efficiency and thereby fixed overhead efficiency variance arises. A change in efficiency means that the actual hours which have been worked will be different from the standard hours of output. Only on the basis of production, recovery of fixed overhead will be done, thus resulting in under- or over- recovery.

The formula is :

$$\text{Standard fixed overhead rate per hour} \times (\text{Actual hours} - \text{Standard hours of actual output})$$

$$\text{Or, } \text{Standard fixed overhead rate per unit} \times (\text{Standard output in actual hours} - \text{Actual output})$$

$$\text{Or, } \text{Fixed Overhead recovered} - \text{Standard fixed overhead.}$$

Fixed Overhead Calendar Variance :

Where the budget of the fixed overhead is done on a monthly basis and the number of working days in the month varies, a calendar variance may be included in the volume variance. Even in situations when the whole year has been divided into a number of budget periods, and equal number of days is there in each budget period, calendar variance may result from the uneven number of holidays falling within each period. For the year, the sum of the calendar variances will always be nil.

The formula is :

$$\text{Excess/deficit hours worked} \times \text{Standard fixed overhead rate per hour}$$

$$\text{Or, } \text{Increase/decrease in production due to excess/deficit hours worked} \times \text{Standard fixed overhead rate per unit}$$

Relationship between the Variances

Fixed Overhead Cost Variance = Expenditure Variance + Volume Variance

Fixed Overhead Volume Variance = Capacity variance + Efficiency Variance

**Or, Fixed Overhead Volume Variance = Capacity variance + Idle time variance
+ Efficiency Variance + Calendar Variances.**

2.5.3 Budgetary Control

Businesses need to plan for the future. In large businesses such planning is very formal while, for smaller businesses, it will be less formal. Planning for the future falls into three time scales:

- Long-term: from about three years up to, sometimes, as far as twenty years ahead
- Medium-term: one to three years ahead
- Short-term: for the next year

A budget is a formal expression of policies, plans, objectives and goals laid down for a definite period in the future. The budget expresses revenue goals in the sales budget and expense limitations in the expense budgets that must be attained to realize the desired profit objective.

The Institute of Cost and Management Accountants, London, defines budgets as, "Financial and/or quantitative statements, prepared prior to a definite period of time, of the policy to be pursued during that period for the purpose of attaining a given objective.

The basic elements of a budget are :

- (a) It is a future plan of activity for a specified period of time.
- (b) It is expressed in physical or monetary units or in both.
- (c) It is prepared in advance, i.e., before the period during which it is to operate.
- (d) The objectives to be attained and the policy to be pursued to achieve those objectives are required to be laid down before its preparation.

Budgetary control involves the use of budgets and budgetary reports throughout the period of budget to coordinate evaluate and control day-to-day operations in accordance with the goals specified by the budget. Budgetary control involves a constant checking and evaluation of actual results compared with the budgeted goals, which should result in corrective action where indicated.

The Institute of Cost and Management Accountants, London, defines budgetary control as, "The establishment of budgets relating the responsibilities of executives to the requirements of a policy and the continuous comparison of actual with budgeted results, either to secure by individual action the objective of that policy or to provide a basis for its revision."

Objective of Budgetary Control

Planning : Planning are all activities well in advance according to the policies of the business so that the goal of the business may easily be achieved.

Co-Ordination : There are many departments in a business which carry on different functions. A Co-ordination is maintained among these departments by budgetary control so that all activities may be performed efficiently and the business may attain its goal.

Control : The object of budgetary control is to control the various activities of the business to attain the most desirable results.

Benefit of Budget and Budgetary Control

- **The Budget Assists Planning** : By formalizing objectives through a budget, a business can ensure that its plans are achievable. It will be able to decide what is needed to produce the output of goods and services and to make sure that everything will be available at the right time.

- **The Budget Communicates and Co-Ordinates** : Because a budget is agreed by the business, all the relevant managers and staff will be working towards the same end. When the budget is being set, any anticipated problems should be resolved and any areas of potential confusion clarified. All departments should be in a position to play their part in achieving the overall goals.
- **The Budget helps with Decision-Making** : By planning ahead through budgets, a business can make decisions on how much output - in the form of goods or services - can be achieved. At the same time, the cost of the output can be planned and changes can be made where appropriate.
- **The Budget can be used to Monitor and Control** : An important reason for producing a budget is that management is able to use budgetary control to monitor and compare the actual results (see diagram below). This is so that action can be taken to modify the operation of the business as time passes, or possibly to change the budget if it becomes unachievable.
- **The Budget can be used to Motivate** : A budget can be part of the techniques for motivating managers and other staff to achieve the objectives of the business. The extent to which this happens will depend on how the budget is agreed and set and whether it is thought to be fair and achievable. The budget may also be linked to rewards (for example, bonuses) where targets are met or exceeded.

Limitation of Budget and Budgetary Control

- **The Benefit of The Budget must Exceed the Cost** : Budgeting is a fairly complex process and some businesses - particularly small ones - may find that the task is too much of a burden in terms of time and other resources, with only limited benefits. Nevertheless, many lenders - such as banks - often require the production of budgets as part of the business plan. As a general rule, the benefit of producing the budget must exceed its cost.
- **Budget Information may not be Accurate** : It is essential that the information going into budgets should be as accurate as possible. Anybody can produce a budget, but the more inaccurate it is, the less use it is to the business as a planning and control mechanism. Great care needs to be taken with estimates of sales - often the starting point of the budgeting process - and costs. Budgetary control is used to compare the budget against what actually happened - the budget may need to be changed if it becomes unachievable.
- **The Budget may Demotivate** : Employees who have had no part in agreeing and setting a budget which is imposed upon them, will feel that they do not own it. As a consequence, the staff may be demotivated. Another limitation is that employees may see budgets as either a 'carrot' or a 'stick', i.e. as a form of encouragement to achieve the targets set, or as a form of punishment if targets are missed.
- **Budgets may Lead to Non-Functional Management** : A limitation that can occur is that employees in one department of the business may over-achieve against their budget and create problems elsewhere. For example, a production department might achieve extra output that the sales department finds difficult to sell. To avoid such Non - functional management, budgets need to be set at realistic levels and linked and co-ordinated across all departments within the business.
- **Budgets may be set at too Low a Level** : Where the budget is too easy to achieve it will be of no benefit to the business and may, in fact, lead to lower levels of output and higher costs than before the budget was established. Budgets should be set at realistic levels, which make the best use of the resources available.

Difference between Budget, Budgeting and Budgetary Control

The difference between budget, budgeting and budgetary control may be stated thus - Budgets are the individual objectives of a department, etc. whereas budgeting may be said to be the act of setting budgets. Budgetary control embraces all and includes the science of planning the budgets themselves and utilization of such budgets as an overall management tool for the business planning and control. Thus, the term budgetary control is wider in meaning and it includes both budget and budgeting.

Types of Budget

(A) Classification on Time Basis

1. Long- Range Budget
2. Short - Range Budget
3. Current Budget

(B) Classification on Functional Budget

1. Sales Budget
2. Production Budget
3. Production Cost Budget
4. Material Cost Budget
5. Labour Cost Budget
6. Factory Overhead Budget
7. Plant Utilization Budget
8. Administrative Overhead Budget
9. Selling overhead Budget
10. Master Budget
11. Research Development Budget
12. Cash Budget
13. Marketing Budgeting

(C) Classification on Flexible Basis

1. Flexible Budget
2. Zero Based Budget
3. Performance Budget
4. Activity Based Budgeting
5. Fixed Budget

(A) Budgets Based on Time

1. Long Range Budget : Long Range Budget is prepared for attaining the goals of a business in a long period of time. Long - term plans of the business are projected in such budgets. Their term may be anywhere from 3 year to 20 years. Preparing long Budget factors like the market trends, economics features, population growth, industrial production data etc.

2. Short Range Budget : These Budget are prepared generally for 2- 3 years. Such budget are supplementary to the long - term budgets.

3. Current Budget : A current Budget means the budget for the current accounting year only. This budget for 3 months, 6 months, or 12 months depending upon the nature of the business.

(B) Functional Budget

1. Sales Budget : The budget shows sales in terms of quantity and value, analysed by the product, by month, by region, by channel of distribution and by salesman.

2. Production Budget : The aim of the production function is to supply finished goods of a specified quality to meet marketing demands. The distribution budget specifies finished goods stock levels and this can be related to the sales budget to give detailed production requirements.

Following from this, it is necessary to consider a series of subsidiary budgets :

- i. Raw Materials Budget; It paying appropriate attention to the desired stock levels.
- ii. Labour Budget: It ensures that the plan will make available at the right times the required number of employees of suitable skills
- iii. Manufacturing Overheads budget: It covers items such as consumable materials and waste disposal.

3. Production Cost Budget : If the estimates of the cost are also given in the production budget along with the quantity, then it will be known as production cost budget. This budget can be classified on the following basis.

- On the basis of products
- On the basis of production department
- On the basis of period
- On the basis of elements of cost

4. Material Cost Budget : Material Cost Budget is the first cost Budget. It is generally concerned with the direct material. This budget shows as to how much quantity of material would be required in order to produce a certain predetermined quantity of the product. Material cost Budget also helps in preparing Material Purchase Budget.

The basic calculation used by the direct materials budget is :

- + Raw Material required for production
- + Planned ending inventory balance
- = Total raw materials required
- Beginning raw materials inventory
- = Raw materials to be purchased

5. Labour Cost Budget : It is ensuring that the plan will make available at the right times the required number of employees of suitable skills.

6. Factory Overhead Budget : In Factory overhead budget Indirect Material, Indirect labour and other indirect Expenses are incurred. A budget has to be prepaid for these expenses also. Fixed, Variable and Semi Variable.

7. Plant Utilization Budget : If the manufacturing process in a factory is mainly accomplished with the help of machine. It is necessary to prepare the plant utilization budget. Following information is needed for preparing this budget.

- Type of number of machine
- Efficiency of each type of machine.
- Workload on each type of machine.
- Estimated future working life of machine.
- Proposed Procedure for purchase of new machine.

8. Administrative Overhead Budget : The budget deals with such expenses as office salaries and upkeep, depreciation, stationery, management salaries, telephones, postage, etc.

9. Selling overhead Budget : The budget includes salesmen's salaries, commission, expenses and related administrative costs. Selling and distribution department is divided in many sections. It is also known as selling and distribution cost budget.

10. Master Budget : Master budget is such a summary budget which incorporates all the component functional budget. Summary budget is that which is prepared with the help of all the component budget and present the summary of these budget.

Master budget is placed before top executive of the management. If the top management is not satisfied with the same amendment are made and then the revised budget is passed. Master budget present the estimates about gross profit, net profit and its appropriation also for a certain budget period.

11. Research Development Budget : The budget covers materials, equipment and supplies, salaries, expenses and other costs relating to design, development and technical research projects. Manager should consider both long term and short term costs incurred on these activities.

From long term point view a manager should see that expenditure incurred on research and development confirm to the future market trend on demand. From short term point view, it should be seen that expenditure is incurred on activities under research development which assured a satisfactory profit.

12. Cash Budget : Cash budget represents the cash receipts and payment and the estimated cash balance for each month of the budget period. The cash budget, as its name implies, summarizes the estimated cash receipts and the estimated cash payments over the budget period. Its object is to ensure a balance between liquidity and profitability.

The cash budget is concerned with the timing of receipts and payments of cash (cash basis), whereas the other budgets are concerned with the timing or incurrence of the transactions themselves (accrual basis).

There are two methods of preparing a cash budget:

- (a) Receipts and payments method and
- (b) Funds flow method

Forms of Cash Budget

Monthly cash Budget : In this budget particulars of expected cash receipts and payment on different dates of a certain month are given.

Quarterly Cash Budget : Monthly estimates of cash receipts and payment are presented in this budget. Cash receipt are estimated for three months of the year and presented month wise in the budget.

Annual Cash Budget : This is a summary of the estimated cash receipts and payments month wise for all 12 months of a year.

13. Marketing Budget : Apart from details of all advertising, promotional activities, public relations, marketing research, customer service and so forth, the marketing budget can also include a summary of the sales, selling expenses and distribution expenses budgets

(C) Flexibility Budget

1. Fixed Budget : Fixed budget is a budget prepared without considering the actual level of activities attained and it remains unchanged. Fixed budget is prepared on the assumption that activities will remain stable at a certain level and all expenses are estimated for that level of activities only. In these budget a target is fixed for the activities during the budget period and all the department starts functioning in joint efforts to attain that target but in actual all the conditions do not remain constant as per assumed estimated.

2. Zero-Base Budgeting (ZBB) : As a modern technique of budgeting, considered ideal for planning and decision making, ZBB was first applied by the United States department of agriculture as early as in 1964. The conceptual framework and structural development of ZBB was made by Peter A. Pyhrr who applied it in Texas Instruments, a multinational company of United States in 1969.

I.C.M.A., London, defined ZBB as "a method of budgeting whereby all activities are re-evaluated each time a budget is formulated. Each functional budget starts with the assumption that the function

does not exist and is at zero cost. Increments of cost are compared with increments of benefits culminating in the planned maximum benefit given by budgeted cost."

Main Features of ZBB

The following are the principal features :

- Zero (or scratch) is taken as the basis of budgeting and not the targets of previous budgets.
- Management of each decision unit must have to justify the fund demanded.
- All proposed activities are grouped into various decision packages.
- All decision packages are adequately evaluated and arranged according to priority.
- Alternative decision packages are also taken into consideration after evaluating properly.
- Final allocation of resources is done on the merits of evaluation of all decision packages including the alternative decision packages.

Traditionally budgeting is done on the basis of the targets set in the last year. Certain additions and deductions are made in the last year's budget figures- to arrive at the figures for the current budget. Thus, in traditional budget making we depend on the last year's targets and on the principle of increment or decrement to decide upon the additions and deletions required to be incorporated in the previous budget figures to arrive at the current budget figures.

In case of ZBB it is assumed that there was no previous year's budget and the current budget proposals are independently evaluated in the light of expected benefits and costs involved. ZBB, therefore, refers to formulating a budget without making any reference to previous plans and achievements, but making particular reference to the justification of the proposed allocation of resources. This is not once. Every time a budget is to be prepared, the process of budgeting should start from zero and the proposed allocation of resources should be justified in terms of cost-benefit analysis.

ZBB is very suitably applicable in planning and development areas particularly of the government and local bodies. Projects of every ministry are thoroughly examined with reference to costs and benefits. Which projects of which ministry shall enjoy priority in respect of allocation of resources depends upon the report of cost-benefit examination by persons competent to do so. Where the resources are limited but there are many development works to be done as in case of educational institutions, local bodies etc. ZBB becomes ideal, because efficient use of limited resource is almost guaranteed.

3. Flexible Budget : Flexible budget is a budget which by recognizing the difference between fixed, semi- fixed and variable costs is designed to change in relation to the level of activity attained. A flexible budget reflects the effect of changes in the budgeting environment which affect the performance of the budget, it does not confine itself to only one level of activity and actual results do not have to be compared against budgeted costs at the original activity level.

4. Activity Based Budgeting (ABB) : Activity based budgeting (ABB) is similar to activity based costing (ABC) and activity based management (ABM). ABB actually involves planning and controlling along the lines of value adding activities and processes. Resource and capital allocations decisions are consistent with ABM analysis, which involves structuring the organization's activities and business processes so that they had better meet customers and external need.

5. Performance Budget : This is a budgeting system which classifies items according to direct output of activity, intermediate product, activities and purpose. It focuses on output or outcome rather than input and it is characterized by expenditure by work load or unit cost of activity primary features tasks, activities orientation management.

2.5.4 Costing for Decision Making

Decision Making involves the act of selecting one course of action from among various feasible alternatives available. Many quantitative and qualitative aspects have to be taken into account in decision making. The manager chooses that course of action which he considers as the most effective for

achieving goals and solving problems. Decision making is an integral part of all management functions like planning, organization, coordination and control.

The term 'cost' is having multiple nuances. It has different meanings in different situations. A cost accountant examines each situation in depth to decide the kind of cost concepts to be used and plays an important role in decision making by making precise and relevant data available to the management.

There are chiefly two kinds of decisions involved in the decision making: long term and short term decisions. Short term decisions, usually, are particular in nature. The specificity of information for the decision making relies on the given situation calling for a decision. Here, such information is called the 'relevant data'. The short term decisions are mostly affected within a year. Such short run operating decisions may involve a host of special non recurring decisions such as make or buy; sell or process; accept or reject an order and other decisions.

The long term decisions force the management to look beyond the current year. Time value of money and return on investment are major considerations in long term decisions. Uncertainty is an integral part of the decision making. Hence, the task of decision making is quite difficult, crucial and critical.

Different Costs for Decision Making

In management accounting system, each product is usually charged with a portion of indirect costs, which are not traceable to the product. Hence, cost data drawn from the cost accounting system are often not relevant as they are historical costs. Therefore, such cost that alternatively keeps on oscillating may in future be qualified for the relevant cost.

(1) Marginal Costing : It includes only variable costs and it does not include fixed costs. At any particular level of output, a change in the total cost by increase or decrease of one unit is called marginal cost. Marginal costing is based on variable cost so that the management can take decisions on the basis of variable costs. Marginal costing is extremely useful for decision making. In fact, it is a major tool for decisions making.

(2) Sunk Cost : It refers to the money already spent and permanently lost. Sunk costs are past opportunity costs that are partially (salvaged, if at all).

Therefore, it should be considered irrelevant to future decision making. Sunk costs are those costs which do not change under given circumstance and do not play any role in decision making process. They are historical costs that had incurred in the past. In other words, these are the costs which have been incurred by a decision made in the past and cannot be changed by any decision to be made in the future. This cost is also known as Committed Cost and Historical Cost.

(3) Opportunity Cost : The opportunity cost of the value of opportunity foregone is taken into consideration when alternatives are compared. Opportunity cost is the value of the next best alternative. In other words, it is the opportunity cost lost by diversion of input factor from one use to another. It is the measure of the benefit of opportunity foregone. Opportunity cost is a pure decision making cost. It is an imputed cost, which does not require cash payout.

The opportunity cost is helpful to managers in evaluating various alternatives available when multiple inputs can be employed for multiple uses. These inputs may nevertheless have a cost and this is measured by the sacrifice made by the alternative action in course of choosing another alternatives.

"The value of a benefit sacrificed in favour of an alternative course of action." C.I.M.A. London

(4) Imputed (Notional) Cost : This is similar cost to the opportunity cost in that they are not recorded in the accounting books. However, they are hypothetical costs that must be taken into consideration if a correct decision is to be arrived at. In auditing it requires special treatment. Imputed cost comes from what one could have made from an asset if you had used it differently.

If one has money tied up in assets that are declining in value, or in accounts receivable, audit standards allow one to deduct an imputed cost for that money. In accounting, the expenses of unreimbursed goods and services are provided by one entity to another entity. It is an expense that is borne indirectly. For example, notional rent charged on business premises owned by the proprietor or interest on capital for which no interest has been paid.

(5) Fixed Costs : The cost which always remains fixed irrespective of production volume is known as fixed costs. This cost remains constant whether production activity is increased or decrease. It doesn't mean that fixed costs are fixed for all time to come. It is subject to change over a period of time.

The fixed cost per unit will become smaller with increase in volume because fixed costs are unaffected by volume changes, any increase in volume implies that the cost will be allocated to a more number of units and vice versa. For short term managerial decision making, fixed cost may be relevant or irrelevant. When a particular decision is made that results in occurrence of fixed cost, it is relevant but if it occurs irrespective of any decision taken in a certain situation then it is irrelevant cost. From the viewpoint of Profit Planning and Control, it is useful to sub divide fixed cost into two types i.e.

'Committed Fixed Costs' and 'Discretionary Fixed Costs'

(6) Variable Costs : The cost which varies with the production volume is known as variable cost. It suggests that this cost varies with the increase or decrease in production. It is so because the input of raw material is used in the exact quantities needed for production process. From the viewpoint of their behavior, variable costs are also known as 'Engineered Cost'. Though it is believed that all variable costs are relevant, it is actually not so because if variable costs vary depending on different alternatives for decision making process.

(7) Out of Pocket Cost : Out of Pocket costs are those expenses which are current cash payments to the outsiders. All the explicit costs like payment of rent, wages, salaries, interest, transport charges etc. fall in category of out of pocket costs. This cost is useful while taking decision like make or buy and price fixation during depression. When availability of fund or cash resources is limited, this type of cost becomes decisive in decision making process.

(8) Book Cost : Book costs are those business costs that do not involve any cash payment. However, a provision is made for book costs where of they are considered under the profit and loss account. This exercise enables the company to gain tax benefits. Here, the provisions for book costs, for example, could be depreciation, unpaid amount of the interest on the owner's capital employed in the firm among others.

(9) Replacement Cost : It is a cost at which an asset or material was purchased that would replace the previous valuables. It is the cost of replacement at current market price.

(10) Avoidable Cost and Unavoidable Cost : These costs can be avoided in future as a result of managerial choices because the management can choose not to incur them. Particular avoidable costs are often compared with the decision alternatives. For instance, salary paid to employees in the section can be stopped if the section is terminated. Unavoidable cost is that cost which will not be eliminated with the discontinuation of a product or section. For instance, salary of company manager cannot be stopped even if a product is terminated.

(11) Differential Cost : Differential cost (which may be incremental cost or decrement cost) is the difference in the total cost that will arise from the selection of one alternative instead of another. It involves the estimation of the impact of decision alternatives on costs and revenues. The two basic concepts which go together with this type of cost analysis are 'incremental cost and incremental revenue and decrement costs and decrement revenue.' It is used generally as a synonym to relevant cost. If the change in the cost is in the increasing mode, it is called incremental cost; if it is decreasing with the decrease in output, it is decrement cost. Incremental revenue increases between two alternatives, while decrement revenue decreases between two alternatives.

Types of Decision Making

The strategic managerial decisions are made on the following types with the use of differential cost analysis and marginal costing :

(1) Make or Buy Decisions : Sometimes firms have to choose from the available resources as to whether manufacture certain components themselves or acquire them from outside suppliers. For this, incremental analysis provides solution. Committed costs are very important input information. If the firm had adequate idle capacity to make the components, then the firm would not require incurring fixed costs for producing the components.

Make or Buy decisions will be taken with the help of marginal costing in the following manner

- (i) in a situation where a firm, although capable of manufacturing, fails to actualize its production and fulfills its requirements from external sources, then the purchase plus fixed cost of manufacture to take decision to make or buy.
- (ii) When the productive capability exists and it is utilized for manufacturing other products, the purchase price should be compared with the marginal cost of the product plus opportunity cost,
- (iii) When there is no additional capacity in effect and it is proposed to acquire additional facilities for manufacturing, the purchase price should be compared with the marginal cost plus fixed cost likely to be incurred for manufacturing with additional facility.

Before taking a decision regarding make or buy one must consider,

- (a) The strength of the company as regards personal, plant, space and other amenities.
- (b) The differential cost of making them or buying them from the market,
- (c) The opportunity cost of existing capacity and
- (d) The variable overheads which are charged to any item.

(2) Adding and Dropping Product Line and other Segments : A segment should be added only if the increase in Total Contribution Margin is greater than the increase in fixed cost. A segment should be dropped only if the decrease in Total Contribution Margin is less than the decrease in fixed cost. Before deciding for adding or dropping product line or other segment, Allocated Common Costs should be taken into consideration.

Some major points to be considered for discontinuation of product as follows :

- (a) Highly competitive nature of the product
- (b) Value of resources released on discontinuation
- (c) Contribution margin earned from that product

(3) Purchasing or Leasing: While taking decision regarding capital investment : Company management will think on the two available alternatives, i.e. whether to purchase the required assets or to lease it from the outside. To take such decisions, company will compare the total cost of both the alternatives and will try to know the additional savings. If the additional savings occur after purchasing it, then it should be purchased and if the additional savings are from leasing it then it should be leased.

(4) Shut Down Costs : It is a point of operation where a firm is indifferent to continuing operations and shutting down temporarily. The shutdown point is the combination of output and price where a firm earns just enough revenue to cover its total variable cost. Shutdown cost is that cost which the firm incurs when it temporarily stops its operations. These costs could be saved if the operations are allowed to continue. Beside fixed costs, shutdown costs include the cost of sheltering plant and equipment, lay off expenses, employment and training of workers when the plant is restarted and above all loss of market. It occurs when a firm suspends its activities temporarily or permanently. Temporary shutdowns are usually due to a maintenance or strike, while permanent shutdowns are typically synonymous to going out of business. While calculating shutdown costs, one must only consider the cost that would not occur if the firm continues its operations.

The other important factors to be considered are :

- (a) In case of shutting down the business, other companies may get a chance to establish their product and business.
- (b) If the production is suspended, the product would be lost from public memory and when the business restarts, it would take a heavy expenditure on marketing.
- (c) Once the skilled workers are discharged it might be difficult to get experienced and skilled workers when the business resumes.
- (d) Machines and equipment become obsolete because new technological changes continuously happen.
- (e) Closing down business for limited period or specific activity may leave and adverse impact on the company or sully its reputation.

Non collection of dues from debtors is one the major worries in case of the closure of business.

(5) Acceptance or Rejection of/ Foreign Orders or Exploring New Markets : Acceptance or Rejection of special order frequently happens. The opportunity arises for the management to consider an order for a quantity of its regular product at a special price (usually less than that charged regular customers). When there is excess or idle production capacity, such a situation may be attractive. The firm usually gets inclined to accept special offer because of its idle status which makes its operating level below its full capacity. But should it be accepted at the price quotation given by the buyer or at some negotiated price ? Such a special order will not affect the regular sales of the same product. If there is no idle capacity, the question of accepting or rejecting an order does not arise.

This decision is entirely based on differential cost and the contribution margin. The real analysis of cost and revenue employs the relevant cost approach. Irrelevant items should be excluded from the analysis. Fixed cost does not increase generally by accepting orders. In other words, fixed costs typically will not change in total irrespective of the acceptance or rejection of the order. But incremental fixed cost is a relevant cost. In case of variable costs, it increases by accepting order. If the price offered is more than the marginal cost, that proposal may be accepted. But when the price offered is less than the marginal cost, that offer is to be rejected. In such a decision, some qualitative factors are considered such as :

- i. The impact on future earnings
- ii. Effect on existing customers
- iii. Selling additional units beyond the present order
- iv. Capacity expansion etc.

In the process of decision making, the income statement is generated which clearly shows the marginal cost, fixed cost and profit. If the profit increases on acceptance of the order, that order should be accepted and if not then it should be rejected.

(6) Sell or Process Further Decision: In some manufacturing processes, several : Intermediate products are produced from a single input. Such products are known as joint products. The costs associated with making these products up to the point where they can be recognized as separate products (the split off point) are called joint product costs.

Sooner or later a decision often has made about selling a joint product as it is or after processing it further. It is profitable to continue processing a joint product after the split off point so long as the incremental revenue from such processing exceeds the incremental processing costs. In such decisions, the joint product costs incurred before the split off point are irrelevant and should be ignored.

(7) Special Orders : Special orders are one time orders that do not affect a company's normal sales. The profit from a special order equals the incremental revenue less the incremental costs. As long as the incremental revenue exceeds the incremental cost and present sales are unaffected, the special order should be accepted.

(8) Utilization of Constrained Resources : Whenever the demand exceeds the productive capacity, a production constrains (bottleneck) comes into existence. This means that the company is unable to fill all orders and some choices have to be made as regards fulfillment or non fulfillment of orders.

Total contribution margin will be maximized by promoting those products or by accepting those orders that provide the highest unit contribution margin in relation to the constrained resources.

(9) Technology Replacement : A management often faces this decision when choice has to be made between retention of technology or its replacement.

This decision is based on the consequent savings in the cost after installing a new machine which would result in the increased profitability. Replacement of technology is a capital investment or a long term decision requiring the use of discounted cash flow technique. This question arises when the outmoded technology has finished its useful life and that there is no alternative left but to replace it with the current technology. Here, some additional fixed cost might incur. Some important aspects for this decision are :

- (a) Significant difference occurs in costs between both the technologies due to depreciation.
- (b) The decision will impact the outflow and inflow of cash for a specific technology.
- (c) The decision of selling the old technology must be considered for the analysis.
- (d) The company must identify as to which time is fit for the replacement of technology as would be help reduce the cost.
- (e) Decisions of increased production improve profitability. However, if the market does not accept the increased production, then installing a new technology becomes futile.

(10) Determining Optimum Product Mix : If company manufactured more than one product, a problem occurs as to the product mix or the sales mix which will earn the maximum gain. The product mix gives maximum contribution to the ideal product mix. Therefore, in order to determine the best product mix, the contribution of each product must be calculated. Moreover, the production must be prioritized in order so that it can give the maximum contribution per unit. The best product mix would be that which increase P.V. Ratio or which reduces break even point.

2.5.5 Process Costing Method

Process costing is a system of costing that applies to manufacturing concerns where the input of raw material in the first process passes through different processes successively, so that the output of one process becomes the input into the next process; finished product being the output of last process. This method is applied in industries where the production flows from the raw material to the finished product continuously from one process to another. The manufacture of the product is generally against stock, based upon the market demand and not against customer's specific orders. Under this method, there may be a multiple number of products of which one will be the main product and the others by-products or joint products. Thus, it is a method of costing used to determine the cost of the product at each process, operation or stage of manufacture. Further, in this method, the finished product of a preceding process becomes the raw material of the following process.

Meaning of Process Costing

According to Charles T. Horngren, "Process costing deals with the mass production of the like units that usually pass in continuous fashion through a series of production steps called operations or processes."

General Principles or Characteristics

The following are the general principles to be followed (main characteristics) under the process costing method:

1. **Cost collection-** The production activities of the factory are classified by process or departments. The boundaries of the process are determined by:
(a) jurisdiction or supervision, (b) similarity of work performed, and (c) physical location of men and machines in the plant. Since a specific product is produced in large volume, process costing is not suitable/compute the cost of specific jobs or product batches.
2. **Particular time period-** All manufacturing costs of particular period are classified by different processes say a month, and the process costing is designed to measure units produced during this time period.
3. **Averaging of cost -** The total cost of each process is divided by the total production of the process and average cost per unit for the period is obtained.
4. **Recording of quantities-** Under this method of costing, production in terms of physical quantities is also recorded in respective process accounts.
5. **Separate ledger-** For each process or department, a separate account is maintained in which records relating to its processing costs incurred are kept properly.
6. **Transfer to finished goods-** Under this method, cost of one process is transferred to other and finally to finished goods account are transferred at their final costs. The total cost and cost per unit is thus determined by accumulating costs of different departments.
7. **Cost of spoiled units-** In case of loss or spoilage of units in a department, the loss is borne by the units produced in that department. Thus, the average cost per units is increased.
8. **Work-in-progress-** In case, certain products remain in process at the end of a period, their stage of completion is estimated and inventory is computed in terms of completed products. For example, if 100 units are in process and it is estimated that they are completed only to the extent of 40%, completed products will be taken as 40 units only.
9. **Homogenous product -** Under processing industries, the production is continuous and emphasis is given on uniform or standardised products. It is very difficult to identify a specific unit of output with the time of production. The cost of any particular unit is, therefore, the average cost of production over a period, say a month.
10. **Costing procedure-** Under this method specific procedures are followed to accumulate production costs by processes or departments, to measure valuation of abnormal losses, abnormal gains, equivalent production and to compute unit costs. An account is maintained for each process to which all costs of material, labour, direct expenses and Overheads are debited.

Process Costing vs Job or Contract Costing

The basic points of difference between process costing and job/contract costing can be explained as under:

1. **Collection of cost -** Essentially, a job order system collects costs for each physically identifiable job or batch of work as it moves through the factory regardless of the accounting period in which the work is done; while a process costing system collects cost for all the products worked during an accounting period, and determines unit cost by dividing the total costs for the period by the total number of units worked in the period.
2. **Purpose -** In job costing production is generally executed against customers' orders and specifications whereas in process costing productions is executed for mass consumption on a continuous basis for building stock and for future sale.
3. **Nature of job -** Each job may be different whereas each process is the same and generally production is continuous.

4. **Time period-** In jobs costing, costs are accumulated for a specific product or job without taking into account the period of time whereas in process costing costs are accumulated for specific processes or departments for a given time period and production is measured for specific time periods.
5. **Work-in-progress-** In job costing, one work-in-progress account is maintained whereas in process costing individual work-in-progress accounts are prepared for each process.
6. **Supervision and control** - In job costing greater supervision and control by the management is required whereas in process costing comparatively less control is required since the work-in-processes needs standardisation.
7. **Cost unit** - The cost unit in case of job costing is 'a job' whereas the cost unit in case of process costing is a 'Process'.
8. **Completion of work** - Completion of job is necessary for computation of the cost of the job. Once the job is completed all costs are added to ascertain the total cost of the job whereas in process costing, completion of work is not awaited. For accounting cost per unit in process costing total cost is divided by the output of the process.

Preparing Simple Process Accounts

The preparation of process accounts is very simple if no loss or gain has arisen during the processing of the product. In this situation a separate process account is maintained for each process. All costs of material, labour, direct expenses and apportioned overheads are debited to the process account. The sale value of waste or scrap relevant with the process is credited to the concerned process account. The balancing figure on credit side of the process account will be the accumulated cost of the process and is transferred to the next process as input for that process. Format of process account may be as under:

Process Account

Particulars	Cost Per Unit ₹	Amount ₹	Particulars	Cost Per Unit ₹	Amount ₹
To Direct Material	By Wastage/Scrap
To Direct Wages	By Next Process
To Direct Exps.	a/c (Transfer)		
To Indirect Exps.			
To Other Expenses (if any)			

Illustration : A factory makes two types of articles, A and B, which are subjected to two processes, factory and finishing, and in respect of which labour is recorded separately. Similar materials are used in article, the raw materials cost being the same. Prepare statements showing the process cost for each type of article and percentage of profit thereon from the following information :

	Article A	Article B
Output in units	3,220	1,380
Selling Price per Article	₹ 125	₹ 155
Labour: Factory	₹ 90,000	₹ 60,000
Finishing	₹ 37,500	₹ 12,500

	Factory	Finishing
Raw Materials:	₹	₹
Purchases	1,25,000	45,000
Opening Stock	50,000	17,000
Closing Stock	37,000	12,000
General Charges (total)	50,000	27,000

Apportion General charges in the ratio of direct wages.

Solution : **Factory Process Account**

Particulars	A	B	Particulars	A	B
	₹	₹		₹	₹
To Materials	96,600	41,400	By Finishing		
To Labour	90,000	60,000	Process a/c		
To General			(Transfer)	2,16,600	1,21,400
Charges	30,000	20,000			
	2,16,600	1,21,400		2,16,600	1,21,400

Note : Material used = ₹ 50,000 + 1,25,000 – 37,000 = ₹ 1,38,000 has been apportioned in the ratio of units produced i.e. (7:3). The actual labour cost incurred has been given for both products separately. General expenses are apportioned in wages ratio (3:2). Similarly for finishing process, material used ₹ 50,000 in (7:3) ratio and general expenses in (3:1) ratio.

Finishing Processing Account

Particulars	A	B	Particulars	A	B
	₹	₹		₹	₹
To Factory			By Finishing to		
Process a/c	2,16,600	1,21,400	Finished		
To Materials	35,000	15,000	Stock a/c	3,09,350	1,55,560
To Labour	37,500	12,500			
To General					
Charges	20,250	6,750			
	3,09,350	1,55,650		3,09,350	1,55,650

Statement of Profit

Particulars	A	B
	₹	₹
Total Cost of Processing	3,09,350	1,55,650
Profit (Selling Price - Total Cost)	93,150	58,250
Selling Price (Given)	4,02,500	2,13,900
Profit on Sales	23.14%	27.22%

Processes Having Losses

The difference between the input of quantity and the output quantity in a process will represent the loss in process. In many process industries such losses are common and inevitable. This loss may be in the form of loss in weight or scrap and or wastage. Process loss may be normal or abnormal.

Normal Process Loss

It is the loss which is unavoidable, uncontrollable and very much expected in normal conditions. Normal losses arise because of inherent nature of raw material or incurred of processing of material, for example, losses due to leakage, evaporation, shrinkage, breakage, drying up of material etc. Such losses can be estimated in advance on the basis of past experience or technical specifications. In many cases, when the loss or waste fetches no value, it is recorded only in terms of quantity and the value of production is inflated.

Accounting Treatment of Normal Loss/Wastage

According to the fundamental costing principles the cost of normal process losses are borne by the good production. In this respect quantity and sale value of normal loss is credited to the process in which the normal loss occurs. The excess of total amount on debit side over credit side is considered to be the value of good production. On dividing this process cost by normal output of units, the process cost per unit is obtained.

Abnormal process Loss or Wastage

It arises due to abnormal factors which represent a loss and is over and above the loss. This type of process loss is avoidable and controllable and generally by abnormal or unexpected conditions such as carelessness, machine breakdown, accident, negligence, bad designing and use of defective or sub standard materials or natural calamities. This loss is in excess of the margin anticipated for normal process loss. Such a loss is treated as abnormal loss or wastage.

Accounting Treatment of Abnormal Loss

It is more difficult than that of accounting treatment of normal process loss. Such losses are not absorbed by good production but are valued as good units and transferred to costing profit and loss account.

It is valued as follows :

Cost of abnormal loss or wastage =

$$\frac{\text{Total Cost} - \text{Value of Normal Loss}}{\text{Normal output (in units)}} \times \text{Units of Abnormal Loss}$$

Note : Normal output = Input – units of normal loss. After finding the cost of abnormal wastage, the following journal entry is passed to show the same in abnormal wastage account.

Abnormal Wastage A/c	Dr.
To Process Account	
(Cost of Abnormal wastage)	
Bank Account	Dr.
To Abnormal Wastage A/c	
(Sales of abnormal wastage)	
Costing Profit & Loss A/c	Dr.
To Abnormal Wastage	
(For transfer of balance in abnormal wastage a/c)	

Illustration : Shree Ltd. produces a product which passes through two processes. A and B. On the basis of past experience, the normal loss occurring in the processes, and other data are as follows:

Particulars	Process A	Process B
Normal Loss on input of units in process	10%	7.5%
Scrap value of loss in process per unit	₹ 0.05	₹ 0.10
Material used	₹ 5,000	₹ 2,500
Wages incurred	₹ 5,500	₹ 3,000
Manufacturing Exp.	₹ 2,550	₹ 2,000
Input 10,000 units	₹ 5,000	₹ 7,300
Output in unit	₹ 8,400	

Prepare Process Accounts showing the cost of output.

Process A Account

Particulars	Units	₹	Particulars	Units	₹
To Input of Units	10,000	5,000	By Normal loss		
To Materials		5,000	(10% of 10,000)	1,000	50
To Wages		5,500	By Abnormal loss		
To Mfg. Exps.		2,250	(WN 1 and 2)	600	1,200
			By Process B a/c		
			(transfer)	8,400	16,800
	10,000	18,050		10,000	18,050

Abnormal gain : If the actual process loss is less than the estimated normal loss, the difference is considered abnormal gain. It is kept separate from the cost of normal production and is accounted for in the process accounts in same way as abnormal process loss. The concerned process account is debited with the quantity and value of abnormal gain and the abnormal gain account is credited. The abnormal gain account is debited with the difference in the quantity and value between normal loss and actual loss and normal loss account is credited with actual under recovery of normal scarp, respectively. The balance of the abnormal gain account is transferred to the costing profit and loss account. The entries would be:

- (i) Process A/c Dr.
To Abnormal effectives A/c
(Abnormal effectives debited to Process A/c)
- (ii) Abnormal Effectives A/c Dr.
To Normal Wastage A/c
(Short fall of sale proceeds of normal waste provided for)
- (iii) Abnormal Effectives A/c Dr.
To Costing Profit & Loss A/c
(Balance transferred)

Valuation of Stock-in-Process

Sometimes the total output of a process may not be transferred to next process, some part of the output may be retained in stock. In such a situation, a separate process stock account for each

process may be prepared along with process account. Output of the process will be transferred to the concerned process stock account instead of next process. Transfer to the next process will be made from the process stock account. The process stock account may have opening stock as well as closing stock. The pricing (valuation) of output issued, sold, transferred to the next process and retained in the process stock account as closing stock may be done according to any of the methods of pricing of materials issued discussed in the chapter on 'Materials'.

The following problem illustrates the preparation of process accounts and process stock accounts etc. when output/stocks are valued and transferred to the subsequent process at weighted average cost:

Illustration : The following information for the month of August, 2011 has been ascertained from the costing books of a manufacturing company relating to a product which passed through two processes A and B

	Process A	Process B
Materials used	₹ 16,000	6,000
Direct labour	₹ 24,000	16,000
Works expenses	₹ 3,344	2,780
Input @ ₹ 8 per unit	Units 4,000	-
Output	Units 3,900	3,850
Stock : August 1	Units 400	600
August 31	Units 300	800
Valuation of opening stock	₹ 19	26
Normal wastage in input	2%	5%
Scrap value of wastage per unit	₹ 1	4

Closing stocks are to be valued at cost. Prepare process accounts for the month.

Solution :

Process A Account

Particulars	Units	₹	Particulars	Units	₹
To Input	4,000	32,000	By Normal Wastage a/c	80	80
To Materials		16,000	By Abnormal Wastage a/c	20	384
To Direct Wages		24,000	By Process A Stock @ ₹ 19.20	3,900	74,880
To Works Exps.		3,344			
	4,000	75,344		4,000	75,334

Process A Stock Account

Particulars	Units	₹	Particulars	Units	₹
To Balance b/d	400	7,600	By Process B a/c	4,000	76,720
To Process A a/c	3,900	74,880	By Balance c/d @ ₹ 19.20	300	5,760
	4,300	82,480		4,300	82,480

Note : The cost of production in process A is ₹ 19.20. The closing stock of 300 units are valued at the same price. This is based on this assumption that closing stock remained from the current production. Since the value of opening stock is ₹ 19 per unit given in the problem. The transfer of units to Process B 4,000 units have been valued at ₹ 76,720 is based on FIFO principle.

Process B Account

Particulars	Units	₹	Particulars	Units	₹
To Process A	4,000	76,720	By Normal		
To Materials		6,000	Wastage a/c	200	800
To Direct Wages		16,000	By Process B		
To Works		2,780	Stock a/c @	3,850	1,02,025
Expenses		1,325	₹ 26.50		
To Abnormal					
Effectives a/c	50				
	4,050	1,02,825		4,050	1,02,825

Process B Stock Account

Particulars	Units	₹	Particulars	Units	₹
To Balance b/d	600	15,600	By Finished		
To Process B a/c	3,850	1,02,025	Stock a/c	3,650	96,425
			By Balance c/d @		
			₹ 26.50	800	21,200
	4,450	1,17,625		4,450	1,17,625

Note : Cost of Process B is ₹ 26.50 per unit and closing stock of this process is valued at this rate. The value of opening stock is ₹ 26 per unit given in the problem. The units transferred to finished goods account 3,650 is the balancing figure ₹ 96,425 valued at weighted average cost.

Valuation of Units from Proceeding Process

Sometimes all the units transferred from previous process are not worked in present process. With the result some units of proceeding process remain unworked. These units are the raw material of the process. As such the valuation of such units would be done on the basis of cost of proceeding process. If there is opening stock of such units in the process the value of which is not given in the problem, it will also be valued at the cost of proceeding process, being units of raw materials for concerned process.

Valuation of Working Process

The problem of ascertaining work-in-progress in process industries is very important and generally difficult. In most firms, production is on a continuous basis and so the problem of work-in-progress is quite common. This problem can be solved by calculating equivalent production (units) or equivalent completed (effective) units.

Equivalent Production

Equivalent production means converting the incomplete production into its equivalent completed units. In each process, an estimate is made of the percentage completion of work-in-progress with regard to different elements of costs, viz., materials, labour and overhead. It is most important that the estimate of percentage completion is as accurate as possible. The formula for computing equivalent completed units is :

$$\text{Equivalent Complete Units} = \text{Actual number of units in process of manufacture} \times \text{Percentage of Work Completed}$$

The steps involved in the computation of equivalent production are outlined below :

- Express the opening inventory of work-in-progress in equivalent completed units: This may be done by multiplying the units of opening work-in-progress by the percentage of work required to be done to complete the unfinished work of the previous period,
- Add to (i) above, the number of units completed out of the units introduced during the period.
- Then add to (ii) above, the equivalent completed units of closing work-in-progress. This can be done by multiplying the units of closing work-in-progress by the percentage of work done on the unfinished units at the end of the period.

The equivalent units may be required to be computed in respect of each element of cost, viz., material, labour and production overhead.

The cost of units completed from the unfinished units of the previous period (Opening work-in-progress) plus the units completed of the current period's input, and the units still remaining uncompleted (closing working-progress) should be shown separately.

Illustration : The following details are given in respect of Process B. Calculate equivalent production and evaluate work-in-progress :

Input 2,000 units; Transferred to next Process 1,800 units; Closing work-in-progress 200 units (completed 100% for materials, 75% for labour and 50% for overhead).

Process Cost : Materials ₹ 40,000, Labour ₹ 27,300. Overhead ₹ 13,300

Solution :

(1) Statement of Equivalent Production

Input (units)	Details	Output Units	Equivalent Production					
			Materials		Labour		Overhead	
			% of completion	Units	% of completion	Units	% of completion	Units
2,000	Fully completed Work-in-progress	1800	100	1,800	100	1,800	100	1,800
		200	100	200	75	150	50	100
2,000	Total	2,000		2,000		1,950		1,900

(2) Statement of Cost

Particulars	Cost ₹	Equivalent Production (Units)	Cost ₹
Materials	40,000	2,000	20.00
Labour	27,300	1,950	14.00
Overhead	13,300	1,900	7.00
	80,600		41.00

(3) Valuation of Work-in-progress

Materials	₹ 20 × 200	= ₹ 4,000
Labour	₹ 14 × 150	= ₹ 2,100
Overhead	₹ 7 × 100	= ₹ 700
Total		= ₹ 6,800

(4) Process B Account

Particulars	Units	₹	Particulars	Units	₹
To Materials	2,000	40,000	By Transfer to		
To Labour		27,300	Process C@ 41	1,800	73,800
To Overhead		13,300	By Balance c/d		
			(W.I.P.)	200	6,800
	2,000	80,600		2,000	80,600

Treatment of Process Loss

In the above example there is no loss in process but it is inevitable in many processes. If normal loss in process is given, it is to be compared with actual loss, in case of excess loss, it will be treated as abnormal loss. If it is less than normal loss, it is called as effective or abnormal gain. The following points are to be kept in mind :

- Normal loss is not included in equivalent production,
- The scrap value of normal loss be deducted either from the cost of main raw material or be deducted from overhead cost,
- Abnormal loss will be included in equivalent production and the stage of completion be carefully taken into account. If nothing is given regarding the completion stage of the loss, it should be treated as 100% completed as regards material, labour and overheads.
- Abnormal gain is always 100% completed since there are extra production.

When Opening Balance of Work-in-Process is given :

When opening balance of work-in-process also, given the valuation of work-in-process can be made in following three ways during the assumption made regarding the flow of cost :

- First in first-out (FIFO) method
- Average cost method
- Last in first out (LIFO) method

FIFO Method

In this method, it is assumed that the units first entering the process are completed first. Thus the units completed during a period would consist partly of the units which were incomplete at the beginning of the period and partly of the units introduced during the period. The cost of completed units is affected by the value of the opening inventory, which is based on the cost of the previous period. The closing inventory of work-in-progress is valued at its current cost. This method of process costing is useful when prices are stable.

Illustration : From the following production data relating to a process for the month of March, calculate the equivalent production units and ascertain the cost of completed units and closing work-in-progress.

- 900 units costing ₹ 900 were in work-in-progress on 1st March, 40% complete.
- 10,600 units were put into the process during the month.
- 10,500 units were completed and transferred to next process during the month.
- 1,000 units were in work-in-progress on 31st March, 35% complete.
- The total costs incurred during the month were ₹ 31,470.

Solution :

Computation of Equivalent Units

Units In	Particulars	Units out	Equivalent Production	
			% of Completion	Equivalent Units
900	Opening work-in-progress, completed and transferred to the next process	900	60%	540
10,600	Units introduced completed and transferred to the next process, of the units introduced during the months (10,500-900)	9,600	100%	9,600
	Closing work-in-progress	1,000	35%	350
11,500	Total	11,500		10,490

Average Cost Method

In this method, the opening inventory of work-in-progress and costs are merged with the production and cost of the current period, respectively. An average cost per unit is determined by dividing the total cost by the total equivalent units, to ascertain the value of the units completed and units in progress. This method assumes that the opening work-in-progress, though partly completed in the previous period, is part of the current production. In other words, while calculating the equivalent units, the work done in the past is ignored. This method is generally followed when the percentage completion of opening work-in-progress is not given.

LIFO Method

In this method it is assumed that the units last entering the process are the first to be completed. This assumption has a different impact on the cost of the completed units and the closing inventory of work-in-progress. The completed units will be shown at their current cost and the closing inventory of work-in-progress will continue to appear at the cost of the opening inventory of work-in-progress. This method is preferred when prices are rising.

Inter-Process Profit

Sometimes, the output from one process is transferred to the next process at the cost of production plus pre-determined margin of profit or at market price. If the output is transferred at market price, the difference between the transfer price and the cost of production of the process represents the profit. For example, the per unit cost of production of process I is say, ₹ 20 but its wholesale market price is ₹ 22. In this case the output of Process I will be transferred to Process 2 at ₹ 22 per unit. Thus Process I will generate an interprocess profit of ₹ 2 per unit.

The purpose of transferring output from one process to the next process at inflated cost or market price may be to evaluate the efficiency of performance of each process separately, and exercise effective control over process costs by comparing them with the market price. If the cost of production of any process exceeds the market price, necessary steps may be taken to rectify the situation. Sometimes, it may even be advantageous to buy goods from outside instead of processing them in the factory, upto a certain stage. This transfer will also enable each process to stand by itself and the efficiency and economies of one process will not be enjoyed by the transferee processes. It also helps in introducing and implementing a system of standard costing.

However, the charging of profits in inter-process transfers creates some complications, particularly when the amount of unrealised profits is to be computed. The objectives of transferring output from one process to the next at inflated cost or market price can be achieved by preparing separate cost reports for each process. As is done in the standard costing system. Since the unrealised profits are not

included in the profit a given period, this has no effect on the profit and loss account of the concern as a whole.

When inter-process transfers are affected at profit, the values of process stocks and finished stock include unrealised profits. These values, therefore, require adjustment to the extent of the unrealised profit to show them in the balance sheet. The amount of unrealised profit included in the closing stock of each process can be calculated by the following formula :

$$\text{Closing Stock} \times \frac{\text{Transfer price}}{\text{Total cost of transferee process}} \times \% \text{ of profit on transfer price added in the transferor process.}$$

To determine the amount of unrealised profit in respect of the closing stock of a process beyond process II, one will have to ascertain the element of profit in the components transferred from the earlier processes. For example, if a product after passing through two processes is converted into finished goods, the closing stock of finished goods will contain an element of unrealised profit added to the transfer price of process I and II.

Alternatively, the calculation of the unrealised element of profit may be made by preparing a three-column process account; the first column for total amount, second column for cost, and the third for profit. The profit on the stock in each process and the finished total stock can be determined first by ascertaining the cost of the closing stock and then the profit may be arrived by deducting the cost of the closing stock from the value of the closing stock as shown below:

$$(i) \text{ Cost of Closing Stock} \times \frac{\text{Cost}}{\text{Total amount}} \times \text{Value of closing stock}$$

$$(ii) \text{ Profit} = \text{Value of closing stock} - \text{Cost of closing stock}$$

Illustration : Product A passes through three processes before it is completed. The output of each process is transferred to next process at the amount which yields 20% profit on transfer price. The transfer from process III to finished stock is at cost plus 25%. There was work-in-progress on 31st December. On this date following further information is available.

	Process I	Process II	Process III
	₹	₹	₹
Direct Materials	20,000	5,000	4,000
Direct Wages	15,000	10,000	20,000
Closing Stock	5,000	6,500	9,500

Out of the finished stock, a portion remained at hand valued at ₹ 5,000 and the balance sold for ₹ 1,10,000. Prepare process and Finished Stock Accounts. Question of overhead and opening stock has been ignored. Also show how much reserves will be created for unrealised profits?

Solution :

Process I Account

Particulars	Cost	Profit	Total	Particulars	Cost	Profit	Total
	₹	₹	₹		₹	₹	₹
To Materials	20,000		20,000	By Closing Stock	5,000		5,000
To Wages	15,000		15,000	Process II	30,000	7,500	37,500
T.P. or 25% on Total Cost		7,500	7,500				
	35,000	7,500	42,500		35,000	7,500	42,500

No Profit included in closing stock since prime cost of ₹ 35,000 does not include profit.

Process II Account

Particulars	Cost	Profit	Total	Particulars	Cost	Profit	Total
	₹	₹	₹		₹	₹	₹
To Process I	30,000	7,500	37,500	By Closing Stock	5,571	929	6,500
To Materials	5,000	-	5,000	By Transfer to Process III	39,429	18,071	57,500
To Wages	10,000	-	10,000				
	45,000	7,500	52,500				
To Profit 25% on cost	-	11,500	11,500				
	45,000	19,000	64,000		45,000	19,000	64,000

Amount of Profit included in closing stock = $\frac{7,500 \times 6,500}{52,500} = 929$

Profit of Process II = $\frac{25}{100} (52,500 - 6,500) = ₹ 11,500$

Process III Account

Particulars	Cost	Profit	Total	Particulars	Cost	Profit	Total
	₹	₹	₹		₹	₹	₹
To Process II	39,000	18,071	57,500	By Closing Stock	7,394	2,106	9,500
To Materials	4,000	-	4,000	By Transfer to Finished Stock	56,035	33,965	90,000
To Wages	20,000	-	20,000				
	63,429	18,071	81,500				
To Profit 25% on cost	-	18,000	18,000				
	63,429	36,071	99,500		63,429	36,071	99,500

Amount of Profit included in closing stock = $\frac{18,071 \times 9,500}{81,500} = ₹ 2,106$.

Profit of Process III = $\frac{25}{100} (81,500 - 9,500) = ₹ 18,000$

Finished Stock Account

Particulars	Cost	Profit	Total	Particulars	Cost	Profit	Total
	₹	₹	₹		₹	₹	₹
To Process III	56,035	33,965	90,000	By Closing Stock	3,113	1,887	5,000
To Profit (Balancing figure)		25,000	25,000	By Sales	52,922	57,078	1,10,000
	56,035	58,965	1,15,000		56,035	58,965	1,15,000

Profit related to Closing Stock = $\frac{33,965 \times 5,000}{90,000} = ₹ 1,887$

Reserve for Unrealised Profit	Process II	=	929
	Process III	=	21,106
	Finished Stock	=	1,887
	Total	=	<u>4,922</u>

2.5.6 Activity Based Costing

Horngrén, Sundem and **Strotton**, in their book **Introduction to Management Accounting**, defines ABC as “A system that first accumulates overhead costs for each of the activities of an organisation and then assigns the costs of activities to the products, services or other cost objects caused that activity.”

In the words of **Jawahar Lal**, “Activity based costing is that in which costs are first traced to activities and then to products”. It is a costing system which focuses on activities performed to periodic products.

The **CIMA, London** defines ABC as “Cost attribution to cost units on the basis of benefit received from indirect activities e., ordering, setting up, assuring quality”.

Activity based costing emphasises the need to obtain better understanding of the behaviour of overhead costs and thus it finds to ascertain (i) what causes costs, and (ii) how they relate to product or services. It recognises that in the long-run, most of the costs are not fixed and seeks to understand the forces that cause overhead costs to change over time.

Thus the underlying philosophy of ABC is that the cost responsibility should be shared by all functions of an organisation, ABC gives visibility to costs by detailing the organisation’s activities, their interrelationship and their respective costs. It categorises all inputs by the way in which they are consumed and that leads to an analysis focussing on cost reduction opportunities.

Need of ABC

Activity based costing and its management can provide such information necessary to achieve cost leadership.

The factors, which led to the development of ABC, are given below :

- (i) Traditional costing fails to capture cause and effect relationship.
- (ii) Traditional costing systems are driven by the need to value stocks rather than to provide meaningful product cost.
- (iii) Traditional costing often fails to highlight inter-relationship among activities in different department.
- (iv) Availability of computers has enhanced requirement for improvement in information gathering and use of technology for advanced decision-making to gain competitive advantage.
- (v) Market place is very competitive.
- (vi) Direct labour has shrunk as a percentage of total cost for majority of manufacturing companies. Still it is most common basis of over-loading overheads to products.
- (vii) Product cycles are shorter and demand for quality is higher.
- (viii) Growing dissatisfaction among the working executives in respect of traditional costing that is based on averages and estimation.
- (ix) Growing overhead costs because of increasingly automated production.

Nature of ABC

The nature tells about the basic characteristics or features of the system. The following are important points describing the nature of Activity Based Costing :

1. ABC allows a more refined approach to cost analysis for modelling.
2. The cost model is more explanatory under ABC system.

3. ABC system brings activity measures as a bridge in between the product cost and resources.
4. In this system, the costs are incurred as the units are produced, which have been traditionally treated as variable overheads.
5. ABC recognises that many so-called fixed overhead costs vary in proportion to changes other than production units.
6. In this system, batch level and product level activities are assumed to influence the fixed overhead costs and are accepted as no unit-based cost drivers are calculated.
7. The advantages of ABC system to a company depends on many factors such as level of competition, number of products manufactured, product diversity etc.

Activity based costing breaks down the work process into various activities and tries to workout cost of each of these activities. Further, each of these activities is broken down into two components as under :

- (a) Value added components (VA);
- (b) Non-value added components (NVA)

Customers would rather not pay for. Unnecessary copying and filling, checking, chasing and correcting, overtime working etc. are the common NVA activities. By collecting the total NVA cost by process.

Identification and classification of Activities —

In this step, activities are identified and then classified into different categories that have relationship with the different parts of the production process. For example, direct labour related activities, machine related activities and various support activities.

Creating cost pools —

In the second step, factory overhead costs of different activities are determined and classified into homogeneous cost pools.

After the second step, the factors that influence the cost of a particular activity, are identified. They are known as cost drivers. It is noticeable that direct costs do not need cost drivers because they can be traced directly to a product. But all other factory or manufacturing costs need cost drivers. Cost drivers signify factors, force or events that determine the costs of activities.

(a) Unit level costs

These costs arise from the activities, that are performed atleast once for each unit of product. The costs under this category includes direct materials, direct labour, direct expenses, testing and direct energy cost. These costs directly vary with the volume of units produced and are measured by volume related cost drivers. For example, drilling a hole or attaching a sub-assembly must be done for each unit.

(b) Batch level costs

These costs arise from activities performed once for each batch or lot of products. The costs associated with a batch or lot vary with the number of lots produced and remain fixed with the number of units produced in a batch.

(c) Product level costs

These costs arise from activities performed to support the production of the product type or model. For example, engineering support costs for process modifications, product design, product specification, product enhancement etc. depend on the existence of the product line.

(d) Production Sustaining level cost

These costs arise from all remaining activities required to sustain the overall operation of the manufacturing organisation. Examples of these activities are factory security, maintenance, insurance, administration, factory accounts divisions etc.

Different activity levels and their costs behaviour can be summarised as given in the following table :

S.No.	Activity Level	Various Activities	Costs behaviour
1	Unit level	<ul style="list-style-type: none"> – Material – Energy – Direct labour – Direct expenses 	Costs modify with the number of products produced
2	Batch level	<ul style="list-style-type: none"> – Setup – Quality control – Inspection – Procurement 	Costs vary with the number of lots and remain constant with regard to the size of the batch/lot
3	Product level	<ul style="list-style-type: none"> – Customer liason – Customer satisfaction – Product design – Engineering 	Costs differ with the number of product lines only and remain fixed with respect to batch-size or number of batches
4	Production sustaining level	<ul style="list-style-type: none"> – Maintenance – Insurance – Factory accounts – Plant security 	Costs remain unchanged in regard to the number of product lines, batch-sizes or number of batches.

Activity	Level			
	Unit Level	Batch Level	Product or Processs Level	Production Sustaining or Organisation Level
Direct materials	Y			
Direct labour	Y			
Building maintenance				Y
Inspection/Quality control		Y		
Design changes			Y	
Machine set-ups		Y		
Equipment maintenance			Y	
Expediting products			Y	
Materials movement		Y		
Market research			Y	
Plant manager's duties				Y
Process control			Y	
Machine time/energy	Y			
Plant security services				Y
Ordering a group of parts		Y		
Engineering change orders			Y	
Product specifications			Y	
Factory accounts				Y

J.Innes and F. Mitchell in their case study entitled ‘**Activity Based Cost Management : A Case study of Development and Implementation**’ Identified the main activities and cost drivers as shown in the following table :

Main Activities	Main Cost Drivers
Customer order processing	<ul style="list-style-type: none"> • Order value • Order source (new/old customer) • Order source (customer location)
Material planning/acquisition	<ul style="list-style-type: none"> • Number of material transactions • Volume of material receipts • Volume of material orders
Inspection	<ul style="list-style-type: none"> • Inspection plans • Number of problem suppliers • Gauge usage • Lack of good quality
Product control	<ul style="list-style-type: none"> • Engineering changes • Supplies performance • Number of parts operational • Make versus buy policy • Number of machine changes • Order board changes
Production	<ul style="list-style-type: none"> • Number to be supervised • Shift patterns • Industrial relations issues • Flow of product from assembly • Volume of service part/kit packing
Maintenance	<ul style="list-style-type: none"> • Number of machine breakdowns • Maintenance schedule • Capital expenditure • Activity levels
Systems	<ul style="list-style-type: none"> • Number of systems operational • Number of systems devices • Adequacy of existing systems
Control quality	<ul style="list-style-type: none"> • Inspection plans
Financial accounting	<ul style="list-style-type: none"> • Number of accounting transactions • Number of times accounts produced • Volume of activity • Co-ordinated shipping process
Management accounting	<ul style="list-style-type: none"> • Accuracy of feeder systems • Management requirements • Corporate requirements • Activity levels
Personnel	<ul style="list-style-type: none"> • Recruitment activity • Industrial relations climate • Training requirements

Calculation and interpretation of activity-based information — After cost pool is defined and cost drivers identified, per unit cost of the cost driver is calculated for that pool. This is called the ‘pool rate’ or ‘activity cost base rate’. It links costs and cost drivers with the resources used, symbolically :

$$\text{Cost per unit} = u + b + p + S$$

$$\text{where, } u = \frac{\text{Total unit level costs}}{\text{Total units}}; \quad b = \frac{\text{Total batch level costs}}{\text{Number of units}}$$

$$p = \frac{\text{Total product level cost + fixed cost}}{\text{Number of units produced}}$$

$$S = \frac{\text{Total costs of other remaining activities}}{\text{Number of units produced}}$$

It is simply the quantity of cost driver used by each unit. Thus, at the final stage, the cost pool, cost driver and the pool rate combine to determine how much cost should be assigned to each product/unit.

The cost function assumed is stated as follows : $C = VU + bB + pP + S$

where, C = Total Cost

V = Per unit variable cost

U = Number of units produced,

b = Per batch variable cost,

B = Number of batches produced,

p = Per product line variable cost,

P = Number of product lines, and

S = All other costs that do not vary with some activity measure (fixed overheads/cost).

The cost function recognises that varying costs are due to more than just change in quantity of outputs (U). Costs also vary with the number of batches and the number of product lines. The above cost equation has more explanatory variables under the assumption that additional variables correctly capture how costs vary in a particular factory under study.

ABC v/s Traditional Costing System

The difference between the ABC system and traditional costing system is explained in the following table :

ABC versus Traditional Costing

Basic of Difference		Activity-Based Costing	Traditional Coasting
1	Cause and Effect	ABC brings accuracy and reliability in product cost determination by focussing on cause and effect relationship in the cost incurrence.	It does not pay attention to the cause and effect relationships between resources used and production activities.
2	Assignment of overheads	In the ABC, overhead costs are to be assigned to each major activity and not to departments.	But in this system, overhead costs are allocated to production departments, in the first stage.
3	Collection of overheads	In ABC, many activity based cost pools or cost centres are created.	But in this system, overheads are pooled/collected department-wise.
4	Cost pools	ABC creates separate cost pools for service activities as well, and overhead costs of these service activities are assigned directly to specific products through applying cost driver rates.	But in traditional system, overhead costs of service departments are allocated to production departments, and therefore, in this costing system finally only fewer cost pools exist.
5	Product specification	ABC allocates directly a large part of overhead costs to specific products.	It uses more arbitrary bases for apportionment of overhead costs. It rolls many overhead costs into the total overhead.
6	Complexity	ABC is more complex and costly than traditional system.	Traditional system is an easy and cheap costing system.

Advantages of ABC

1. ABC brings accuracy and reliability in product cost determination by focussing on cause and effect relationship in the cost incurrence.
2. It improves greatly the manager's decision-making as he can use more reliable product cost data.
3. It enables managers to control many fixed overhead costs by exercising more control over the activities that have caused these non-value added costs.
4. It allocates directly a large part of overhead costs to specific products.
5. It improves the overall reporting, control and efficiency drastically.
6. Cost behaviour can be more realistically represented by employing activity - based costing that tends to structure costs in a hierarchy reflecting their variability at different levels.
7. It reveals a wide range of opportunities for cost reduction.
8. With the help of ABC, at each level of factory activity, managers can obtain cost information for re-engineering the production process.
9. It helps in fixing selling prices of different products as more correct data of product cost is available to the managers.
10. It plays an important role in those companies which operate in a more competitive environment and are in dire need of correct product cost data for taking sound business decisions with regard to determination of selling prices, and wants better cost management measures with their own better costing system.

Continuous Improvement and ABC System

Activity based costing system can be integrated with continuous improvement efforts of an organisation to reduce costs. Continuous improvement efforts include both products and processes. Continuous improvement of products means that products are designed to be easier and faster to manufacture and still meet the needs of customers. The features that are eliminated in products are those that customers do not feel to be important.

An organisation can reduce costs by the following four ways :

- (i) **Activity Elimination** : This results from changes to the production process or products.
- (ii) **Activity Reduction** : This means that less time or effort is required to perform an activity.
- (iii) **Activity Selection** : This means that the low-cost alternative from a set of design alternatives is chosen.
- (iv) **Activity Sharing** : This includes choosing design alternative so that economies of scale can be obtained by allowing more than one product to use an activity.

Weak Points of Activity Based Costing

Activity based costing also have some weak points with its advantages, which are as follows:

- (i) It is essentially not the panacea for all ills.
- (ii) It takes no account of opportunity cost.
- (iii) It may lead to weaker customer segmentation.
- (iv) It absorbs a lot of resources.
- (v) ABC requires total commitment and involvement from the members of the non-finance functions also, otherwise the initiatives which are tightly integrated with the operating teams can not be implemented.
- (vi) It requires segregation of management processes into strategic and operational ones. The lack of clarity in the segregation leads to faulty application of ABC concept.

- (vii) ABC implementation agenda should be driven by the top management. If it is not driven so and moved by the accountants, it will not get firm-wide support for the concept.
- (viii) ABC information and reports require due consideration by the operating team. In the absence on the operating team's ability to use the ABC information the concept faces a brain death with the body remaining intact.

Illustration 1 : With the help of following information you are required to calculate the total cost of product under Activity Based Costing :

Activity	Annual Cost Driver Quantity	Cost (₹)	Product Cost Driver Consumption
1. Material	30,000 units	3,00,000	10,000 units
2. Labour	20,000 hours	2,00,000	5,000 hours
3. Setup	20,000 hours	2,00,000	200 hours
4. Production order	150 orders	4,500	18 orders
5. Maintenance	120 machines	4,800	20 Machines

Solution :

ABC System (1)	Pool rate (2)	Cost driver Consumption (3)	Cost Assignment (2×3) ₹ (4)
1. Material	10 per unit	10,000 units	1,00,000
2. Labour	10 per hour	5,000 hours	50,000
3. Setup	10 per hour	200 hours	2,000
4. Production order	30 per order	18 orders	540
5. Maintenance	40 per machine	20 machines	800
			1,53,340

∴ Total cost = ₹ 1,53,340

Illustration 2 : Calculate the costs according to various cost behaviours :

Activity	Activity Cost (₹)
1. Direct Labour	60,000
2. Energy Cost	15,000
3. Inspection	10,000
4. Product design	5,000
5. Insurance	6,000
6. Procurement	7,000
7. Quality Control	8,000
8. Maintenance	10,000
9. Testing	7,500

Solution :

1. Unit level costs	Amount (₹)
Testing	7,500
Direct labour	60,000
Energy cost	15,000
	<u>82,500</u>
2. Batch level costs	
Inspection	10,000
Procurement	7,000
Quality control	8,000
	<u>25,000</u>
3. Product level costs	
Product design	5,000
	<u>5,000</u>
4. Production sustaining level costs	
Insurance	6,000
Maintenance	10,000
	<u>16,000</u>

Illustration 3 : A manufacturing company has been using a cost system that allocates all factory overhead costs to products based on 350% of direct labour cost. The company has just decided to use activity based cost system that traces indirect costs to products based on consumption of major activities as indicated below :

Activity	Annual Cost Driver Quantity	Cost (₹)	Product Cost Driver Consumption
Labour	50,000 hours	50,000	₹ 30,000
Machining	30,000 hours	6,00,000	900 hours
Production order	2,000 orders	4,50,000	20 orders
Material handling	1,500 requisitions	60,000	7 requisitions
Setup	5,000 hours	60,000	60 hours

Required - Compare the total annual overhead costs using both the Traditional volume based and new Activity based costing system.

Cost System	Pool Rate	Cost driver Consumption	Cost Assignment ₹
Traditional Costing System	350%	₹ 30,000	₹ 1,05,000
Activity Based Costing System			
(i) Machining	₹ 20 per hour	900 hours	18,000
(ii) Production order	₹ 225 per order	20 orders	4,500
(iii) Material handling	₹ 40 per requisition	7 requisitions	280
(iv) Setup	₹ 12 per hour	60 hours	720
Total Overhead Cost			₹ 23,500

Conclusion — According to ABC, total overhead cost is ₹ 23,500 whereas under traditional costing system, it is ₹ 1,05,000.

Illustration 4 : Anand Manufacturing Company has five accounts clerks responsible for processing purchase invoices. Each clerk is able of processing 5,000 invoices per year and is paid a salary of ₹ 3,60,000 per annum. With the salary, the company spends ₹ 75,000 per year for postage etc. (assuming that 16,000 invoices are processed). During the year, 15,000 invoices were processed.

You are required to :

- Calculate the activity rate for the purchase order activity and fixed and variable activity rate.
- Calculate the used and unused activity in total activity availability.
- Compute the total cost of supplied resources and divide this into activity usage and unused activity.

Solution :

$$(a) \quad \text{Activity Rate} = \frac{[(5 \times 3,60,000) + ₹ 75,000]}{16,000} = ₹ 117.1875 \text{ per invoice}$$

$$\text{Fixed Activity Rate} = \frac{5 \times 3,60,000}{16,000} = ₹ 112.50 \text{ per invoice}$$

$$\text{Variable Activity Rate} = \frac{75,000}{16,000} = ₹ 4.6875 \text{ per invoice}$$

$$(b) \quad \text{Total activity availability} = \text{Used activity} + \text{Unused activity}$$

$$16,000 = 15,000 + x ; \quad 16,000 - 15,000 = x; \quad 1,000 = x$$

So, used activity = 1,000 invoices

$$(c) \quad \text{Total cost of supplied resources} = \text{Cost of activity used} + \text{Cost of unused activity}$$

$$(5 \times 3,60,000) + (4.6875 \times 15,000) = (117.1875 \times 15,000) + (112.50 \times 1,000)$$

$$18,00,000 + 70,312.50 = 17,57,812.50 + 1,12,500; 18,70,312.50 = 18,70,312.50$$

Therefore, the total cost of supplied resources is ₹ 18,70,312.50, cost of activity usage is ₹ 17,57,812.50 and cost of unused activity is ₹ 1,12,500.

2.5.7 Life Cycle Costing:

Life cycle costing is a system that tracks and accumulates the actual costs and revenues attributable to cost object from its invention to its abandonment. Life cycle costing involves tracing cost and revenues on a product by product base over several calendar periods.

The Life Cycle Cost (LCC) of an asset is defined as:

"The total cost throughout its life including planning, design, acquisition and support costs and any other costs directly attributable to owning or using the asset".

Life Cycle Cost (LCC) of an item represents the total cost of its ownership, and includes all the costs that will be incurred during the life of the item to acquire it, operate it, support it and finally dispose it. Life Cycle Costing adds all the costs over their life period and enables an evaluation on a common basis for the specified period (usually discounted costs are used).

This enables decisions on acquisition, maintenance, refurbishment or disposal to be made in the light of full cost implications. In essence, Life Cycle Costing is a means of estimating all the costs involved in procuring, operating, maintaining and ultimately disposing a product throughout its life.

Life cycle costing is different from traditional cost accounting system which reports cost object profitability on a calendar basis (i.e. monthly, quarterly and annually) whereas life cycle costing involves tracing costs and revenues of a cost object (i.e. product, project etc.) over several calendar periods (i.e. projected life of the cost object).

Thus, product life cycle costing is an approach used to provide a long-term picture of product line profitability, feedback on the effectiveness of the life cycle planning and cost data to clarify the economic impact on alternative chosen in the design, engineering phase etc.

It is also considered as a way to enhance the control of manufacturing costs. It is important to track and measure costs during each stage of a product's life cycle.

Characteristics of Life Cycle Costing:

- a. Product life cycle costing involves tracing of costs and revenues of a product over several calendar periods throughout its life cycle.
- b. Product life cycle costing traces research and design and development costs and total magnitude of these costs for each individual product and compared with product revenue.
- c. Each phase of the product life-cycle poses different threats and opportunities that may require different strategic actions.
- d. Product life cycle may be extended by finding new uses or users or by increasing the consumption of the present users.

Stages of Product Life Cycle Costing:

Following are the main stages of Product Life Cycle:

(i) Market Research:

It will establish what product the customer wants, how much he is prepared to pay for it and how much he will buy.

(ii) Specification:

It will give details such as required life, maximum permissible maintenance costs, manufacturing costs, required delivery date, expected performance of the product.

(iii) Design:

Proper drawings and process schedules are to be defined.

(iv) Prototype Manufacture:

From the drawings a small quantity of the product will be manufactured. These prototypes will be used to develop the product.

(v) Development:

Testing and changing to meet requirements after the initial run. This period of testing and changing is development. When a product is made for the first time, it rarely meets the requirements of the specification and changes have to be made until it meets the requirements.

(vi) Tooling:

Tooling up for production can mean building a production line; building jigs, buying the necessary tools and equipment's requiring a very large initial investment.

(vii) Manufacture:

The manufacture of a product involves the purchase of raw materials and components, the use of labour and manufacturing expenses to make the product.

(viii) Selling**(ix) Distribution****(x) Product support****(xi) Decommissioning:**

When a manufacturing product comes to an end, the plant used to build the product must be sold or scrapped.

Benefits of Product Life Cycle Costing:

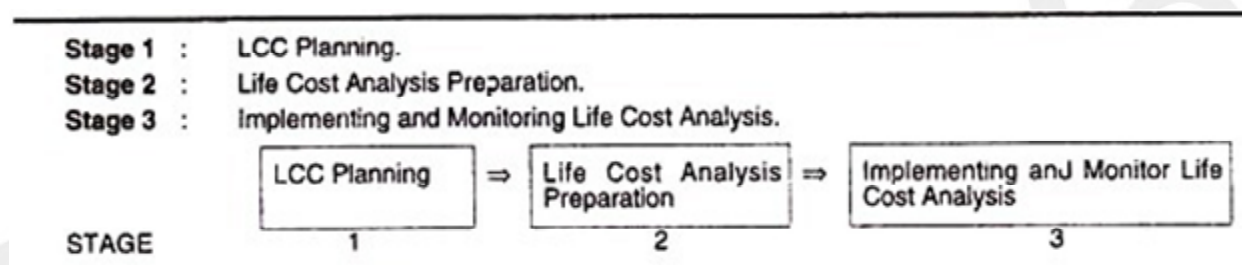
Following are the main benefits of product life cycle costing:

- (i) It results in earlier action to generate revenue or lower costs than otherwise might be considered. There are a number of factors that need to be managed in order to maximise return in a product.
- (ii) Better decision should follow from a more accurate and realistic assessment of revenues and costs within a particular life cycle stage.
- (iii) It can promote long term rewarding in contrast to short term rewarding.
- (iv) It provides an overall framework for considering total incremental costs over the entire span of a product.

Life Cycle Costing Process:

Life cycle costing is a three-staged process. The first stage is life cost planning stage which includes planning LCC Analysis, Selecting and Developing LCC Model, applying LCC Model and finally recording and reviewing the LCC Results. The Second Stage is Life Cost Analysis Preparation Stage followed by third stage Implementation and Monitoring Life Cost Analysis.

The three stages are:

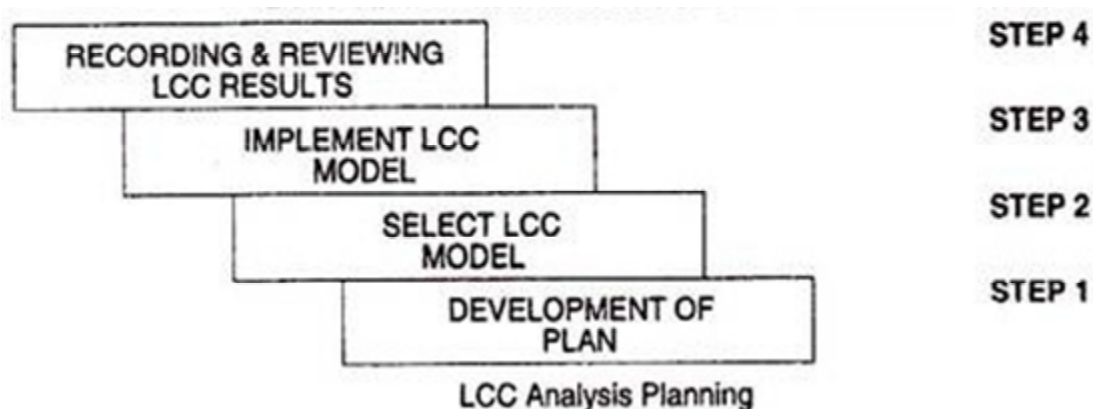


Life Cycle Costing Process:

LCC Analysis is a multi-disciplinary activity. An analyst, involved in life cycle costing, should be fully familiar with unique cost elements involved in the life cycle of asset, sources of cost data to be collected and financial principles to be applied.

He should also have clear understanding of methods of assessing the uncertainties associated with cost estimation. Number of iteration may be required to perform to finally achieve the result. All these iterations should be documented in detail to facilitate the interpretations of final result.

Stage 1: LCC Analysis Planning:



The Life Cycle Costing process begins with development of a plan, which addresses the purpose, and scope of the analysis.

The plan should:

- i. Define the analysis objectives in terms of outputs required to assist a management decision.

Typical objectives are:

- a. Determination of the LCC for an asset in order to assist planning, contracting, budgeting or similar needs.
 - b. Evaluation of the impact of alternative courses of action on the LCC of an asset (such as design approaches, asset acquisition, support policies or alternative technologies).
 - c. Identification of cost elements which act as cost drivers for the LCC of an asset in order to focus design, development, acquisition or asset support efforts.
- ii. Make the detailed schedule with regard to planning of time period for each phase, the operating, technical and maintenance support required for the asset.
 - iii. Identify any underlying conditions, assumptions, limitations and constraints (such as minimum asset performance, availability requirements or maximum capital cost limitations) that might restrict the range of acceptable options to be evaluated. Identify alternative courses of action to be evaluated.
 - iv. Identify alternative courses of action to be evaluated. The list of proposed alternatives may be refined as new options are identified or as existing options are found to violate the problem constraints.
 - v. Provide an estimate of resources required and a reporting schedule for the analysis to ensure that the LCC results will be available to support the decision-making process for which they are required.

Next step in LCC Analysis planning is the selection or development of an LCC model that will satisfy the objectives of the analysis. LCC Model is basically an accounting structure which enables the estimation of an asset components cost.

Stage 2: Life Cost Analysis Preparation:

The Life Cost Analysis is essentially a tool, which can be used to control and manage the ongoing costs of an asset or part thereof. It is based on the LCC Model developed and applied during the Life Cost Planning phase with one important difference: it uses data on real costs.

The preparation of the Life Cost Analysis involves review and development of the LCC Model as a "**real-time**" or actual cost control mechanism. Estimates of capital costs will be replaced by the actual prices paid. Changes may also be required to the cost breakdown structure and cost elements to reflect the asset components to be monitored and the level of detail required.

Targets are set for the operating costs and their frequency of occurrence based initially on the estimates used in the Life Cost Planning phase. However, these targets may change with time as more accurate data is obtained, from the actual asset operating costs or from the operating cost of similar other asset.

Stage 3: Implementing and Monitoring:

Implementation of the Life Cost Analysis involves the continuous monitoring of the actual performance of an asset during its operation and maintenance to identify areas in which cost savings may be made and to provide feedback for future life cost planning activities.

For example, it may be better to replace an expensive building component with a more efficient solution prior to the end of its useful life than to continue with a poor initial decision.

2.5.8 Target costing:**Origin of Target Costing:**

In Japan, target costing is has gained importance and widely practiced in more than 80% of the companies in the assembly industries and more than 60% of the companies in processing industries. It developed in Japan in 1960s as a consequence of difficult market conditions. A proliferation of consumer and industrial products of western firms were overloading the markets in Asia.

Target Costing:

Target costing can be defined as "a structured approach for determining the cost at which a proposed product with specified functionality and quality must be produced to generate a desired level of profitability at its anticipated selling price". A critical aspect of this definition is that it lays emphasis on the fact that target costing is much more than a management accounting method.

CIMA defines target cost as "a product cost estimate derived from a competitive market price"

Target costing is a formal process that attempts to match a proposed product's features (benefits) with a viable market price that achieves the company's profitability goals by:

- (a) Determining a price point (or range of prices) for an approximate combination of features and benefits.
- (b) Subtracting a desired profit from the market price to determine the maximum bearable level of costs.
- (c) Iterating the product design-eliminating or reducing unnecessary attributes with costs that can't be recovered in higher prices-until the cost target is met.
- (d) Revising the market price for the redesigned product in view of changed market conditions.

Steps in Target Costing:

Following are the main steps (or stages) involved in target costing:

- (i) To conduct market research in order to see what products are in the market place, what new products the competitors are trying to bring in the market, to ascertain customers' requirement and the price they can afford for the product.
- (ii) Determining the price, margin and cost feasibility. Target price is determined on the basis of market survey, at which the product can be sold. On the selling price a standard margin is determined to finally come to the cost figure (Target Price - Target Profit = Target Cost).
- (iii) To meet margin target by design improvement. If the product designed cannot be produced in the cost range decided, value engineering is used to drive down the product cost to a level, at which target price and margin can be attained.
- (iv) To implement continuous improvement. This is needed to ensure that targeted cost levels are maintained subsequent to design phase. Value engineering method is applied for reduction of waste, misuse, etc. and for elimination of non-value added costs and processes, etc.

Objectives:

- a. To lower the costs of new products so that the required profit level can be ensured.
- b. The new products meet the levels of quality, delivery timing and price required by the market.
- c. To motivate all company employees to achieve the target profit during new product development by making target costing a company wide profit management activity.

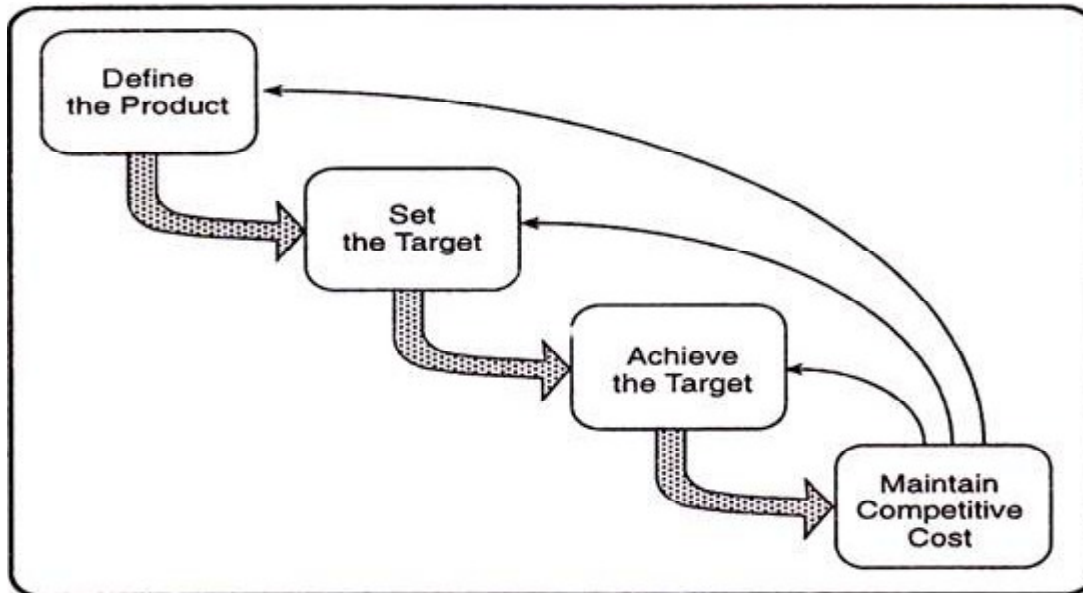
Target Costing Process:

Just as there is no single definition of target costing, there is no single target costing process. All companies share a series of general steps:

- a. Establishing the target price in the context of market needs and competition;
- b. Establishing the target profit margin;
- c. Determining the allowable cost that must be achieved; this cost should motivate all personnel to achieve;
- d. Calculating the probable cost of current products and processes; and finally,
- e. Establishing the target amount by which current costs must be reduced.

Once the target cost has been calculated, companies take the following steps to achieve it:

- Establishing a cross functional team, which is involved in the implementation process from the earliest design stages,
- Using tools such as value engineering in the design process; and
- Pursuing cost reductions using "**kaizen costing**" once production has started.



A number of techniques and tools facilitate an effective and efficient costing process. Three externally oriented analyses market assessment tools, industry and competitive analysis and reverse engineering provide a firm with a foundation for defining the proposed new product and establishing its price.

The determination of the target profit margin relies heavily on the comprehensive and detailed financial planning and statement analysis. Every firm has relationship between prices, volumes and revenues; costs and investments, in the aggregate and for specific product lines and individual products. The management team should explore other tools like value engineering and quality function deployment.

Advantages of Target Costing:

- It reinforces top to bottom commitment to process and product innovation to achieve some competitive advantages.
- It helps to create a company's market-driven management for designing and manufacturing products that meet the price required for the market success.
- It uses management control system to support and reinforce manufacturing strategies, and to identify market opportunities that can be converted into real saving to achieve the best value for money rather than simply achieving the lowest cost.
- Assures that products are better matched to their customers' needs.
- Aligns the costs of features with customers' willingness to pay for them.
- Reduces the development cycle of a product.
- Reduces the costs of products significantly.
- Increases the teamwork among all internal organizations associated with conceiving, marketing, planning, developing, manufacturing, selling, distributing and installing a product.
- Engages customers and suppliers to design the right product and to more effectively integrate the entire supply chain.

Disadvantage :

- a. The development of the process can be lengthened to a considerable extent since the design team may require a number of design iterations before it can devise low cost product that meets the target cost and margin criteria. This occurrence is most common when the project manager is unwilling to discontinue a design project that cannot meet its costing goals within a reasonable time frame.
- b. A large amount of mandatory cost cutting can result in finger pointing in various parts of the company; especially if employees in one area feel they are being called on to provide a disproportionately large part of the saving.
- c. A design team having representatives from the number of departments can sometimes make it more difficult to reach a consensus on the proper design because there are too many opinions regarding design issues.

2.5.9 Kaizen costing

Kaizen costing as “Genkakizen” in Japanese companies. It is used in manufacturing stage of existing products as cost reduction process. Kaizen is derived by Japanese automobile companies.

Yashihuro Moden “the maintenance of present cost levels for products currently being manufactured via systematic efforts to achieve the desired cost level”

KC is applied to product that is already under production for cost reduction. Cost can be reduced through estimation of seven type of waste :

- Over Production
- Inventory Production
- Waiting
- Defective
- Motion
- Transportation
- Over Processing

Implementing Kaizen

- (1) List your own problems
- (2) Grade problem as to minor, difficult and major.
- (3) Start with the smallest minor problem.
- (4) Move on to next graded problem and so on.
- (5) Remember improvement is a part of daily routine.
- (6) Never accepts status quo.
- (7) Never reject any idea before trying.
- (8) Eliminate tried but failed experiments
- (9) Highlight problems rather than hiding.

Process for Implementation

- (1) Form small groups from 6–10 persons.
- (2) Give them numbers – Kaizen 1, Kaizen – 2.....
- (3) Appoint an evaluator of the group.
- (4) Arrange weekly meeting of group (6 – 12 months)
- (5) Submit progress of improvement in writing
- (6) Allow each member to express.
- (7) No disturbance when others are speaking
- (8) However clarification can be sought instantly.

Evaluation

- 0 – Marks for no improvement made
- 0 – 30 Marks depends upon improvement tried but failed.
- 30 – 50 Marks for small to moderate improvement
- 50 to 75 Marks for goods improvement
- > 75 Marks for extraordinary improvement

Kaizen Philosophy		
Approach to	Traditional Organisation	Kaizen Environment
Attitude Improvement	Set it 90·	Continuous
Employees	Cost	Assets.
Information	Restricted	Shared
Interpersonal Relationship	Commercial	Human
Managerial Belief.	Routine	Change
Management Culture.	Bureaucratic	Participative
Management Function	Control	Supportive.
Management stress	Functional	Cross Functional

Advantage of Kaizen Costing

- Customers Satisfaction
- Process Centered
- Create Work Team
- Cross Functional
- Increasing Employees Moral
- Reduced errors
- Promote Openness
- Acknowledge problems openly

Disadvantage

- Requires Permanent change of management system
- Does not produce required result
- Difficult to convince people.

2.5.10 JIT (Just In time)

Just in time Manufacturing also known as just in time production or the Toyota production system (TPS), is a methodology aimed primarily at reducing flow times. Within production system as well as response times from suppliers and to customers.

Development of JIT

- 1960's : Developed as Toyota production system by Taiichi ohno and his colleagues.
- 1970's : U.S and European auto makers began to apply JIT to improve quality and productivity.
- 1990's and beyond : expanded the JIT concept to streamline all type of operation

Definition of JIT

A set of techniques to increase productivity improve quality and reduce cost of an operations.

A management philosophy to promote elimination of waste and continuous improvement of productivity.

Main elements of JIT

- (1) Elimination of waste
- (2) Quality at the source
- (3) Balanced and flexible work flow
- (4) Respect for people
- (5) Continuous improvement (Kaizen)
- (6) Simplification and visual control
- (7) Focus on customer needs

JIT Goals

- Zero defects
 - Zero excess lot size or lot size of one
 - Zero setups
 - Zero breakdowns
 - Zero handling
 - Zero lead time
 - Zero Surging
- * Level production plan and uniform product mix

Type of waste

Waste	Definition
1. Overproduction	Manufacturing an item before it is needed.
2. Inappropriate Processing	Using expensive high precision equipment when simpler machines would suffice.
3. Waiting	Wasteful time incurred when product is not being moved or processed.
4. Transportation	Excessive movement and material handling of product between processes.
5. Motion	Unnecessary effort related to the ergonomics of bending, stretching, reaching, lifting, and walking.
6. Inventory	Excess inventory hides problems on the shop floor, consumes space, increases lead times, and inhibits communication.
7. Defects	Quality defects result in rework and scrap, and add wasteful costs to the system in the form of lost capacity, rescheduling effort, increased inspection, and loss of customer good will.
8. Underutilization of Employees	Failure of the firm to learn from and capitalize on its employees' knowledge and creativity impedes long term efforts to eliminate waste.

Sources of waste

- Overproduction
- Waiting time
- Unnecessary transportation
- Processing waste
- Inefficient work methods
- Product defects

Principle of Jit manufacturing

- Total quality Management
- Production Management
- Supplier Management
- Inventory Management
- Human Resource Management

JIT manufacturing building block

- Product design
- Process design
- Personnel/organizational elements
- Manufacturing planning and control

1. Product Design

- Standard parts
- Design Simplification
- Highly capable production systems
- Concurrent engineering

2. Process Design

- Small lot sizes
- Setup time reduction
- Limited work in process
- Quality improvement
- Production flexibility
- Little inventory storage

3. Personnel element

- Workers as assets
- Cross-trained workers
- Continuous improvement
- Leadership

4. Manufacturing planning and control

- Pull systems
- Visual systems (kanban)
- Close vendor relationships
- Reduced transaction processing (delays in delivery)
- Preventive maintenance

